Aviation Week

Including Space Technology

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A McGraw-Hill Publication

October 19, 1959

Special Report On IATA General Meeting

Atlas 18-D Launched with Operational Nose Cone

The Only Jet Transport to Meet or Exceed Every Performance Estimate

Convair's Jet 880 Powered by General Electric

YEARS AHEAD FOR YEARS TO COME!

In producing the Jet 880, Convair engineers have applied all of the knowledge gained during more than 35 years of building military and commercial aircraft.

The Convair 880 was thoroughly and painstakingly tested in wind tunnels and in static rigs which simulate every aerodynamic stress of flight. Airline pilots and engineers joined with Convair experts in perfecting the clear-vision cockpit. Human Engineering at Convair and contract designers made certain the passenger cabin would be the most luxurious ever planned.

Now after months of intensive flight testing, Convair's 880 has met or exceeded every performance guarantee. Powered by General Electric CJ-805 turbojets, the Jet 880 has proved it can cruise at 615 miles an hour in level flight—the world's *fastest* and most versatile jet transport. Outstanding fuel economy and storage capacity make it ideal for medium and transcontinental routes. With improvements in design and engineering that are as much as five years ahead of other jet transports now in production, the Jet 880, built by Convair, a Division of General Dynamics, has dramatically advanced the scope of the Jet Age—to bring you jet travel that is *years ahead for years to come!*

GENERAL ELECTRIC'S CJ-805—Power Plant for the world's fastest and most versatile airliner—.

Convair's Jet 880 is powered by four General Electric CJ-805 turbojets. Advanced design and light weight of the CJ-805 engines make possible the outstanding thrust and rapid throttle response—from ground idle to full takeoff thrust in only 5.6 seconds. Since 1941, General Electric has been America's leader in the production of jet engines. The CJ-805, a result of this unmatched experience, brings maximum speed and dependability to the Convair Jet 880.

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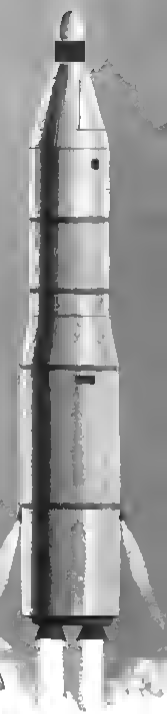
A DIVISION OF **GENERAL DYNAMICS CORPORATION**

First to offer Convair 880 or 600 Jet Liner service will be TWA, DELTA, TRANSCONTINENTAL (Argentina), REAL AEROVIAS (Brazil), S.A.S., SWISSAIR, AMERICAN C.A.T. (Formosa)

BEING INTEGRATED INTO TOMORROW'S AIRCRAFT AND MISSILE SYSTEMS

NEW VICKERS Variable Displacement Hydraulic Pumps with MAXIMUM HP/LB RATIO



Model Series	Displacement cu. in./rev	RPM		Weight lb.	HP/LB*	
		Limited Life	Rated		Limited Life	Rated
PV006	.095	18,200	12,500	2.8	4.55	3.12
PV012	.188	14,500	10,000	4.5	4.45	3.06
PV024	.367	11,600	8,000	6.9	4.53	3.13
PV039	.600	10,000	8,000	10.2	4.33	3.46
PV062	.950	8,900	7,000	14.0	4.44	3.49
PV104	1.600	7,500	5,800	19.0	4.65	3.59
PV163	2.500	6,500	5,100	26.0	4.60	3.60

*This is hydraulic output horsepower at 3000 psi

The above table is important to anyone concerned with the selection of hydraulic pumps for future air or space vehicles. Note particularly the horsepower-to-weight ratios for both rated and limited life speeds. These are the highest known available at this time.

But highest hp/lb is only one of many advantages offered you by the new Vickers advanced design variable displacement pumps. Developed to meet the requirements of the new MIL-P-19692 specification, this new series has volumetric efficiencies of 96% to 98% over a pressure range of 500 to 3000 psi . . . and has 4000 psi continuous operation capabilities. These pumps have faster response and improved contamination resistance; they have practically the same envelope as constant displacement units of equal output. The first five sizes are now being integrated into advanced aircraft and missile systems; the two larger sizes are in the development stage. Write for Bulletin A-5233 for additional information.

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DIVISION OF SPERRY RAND CORPORATION

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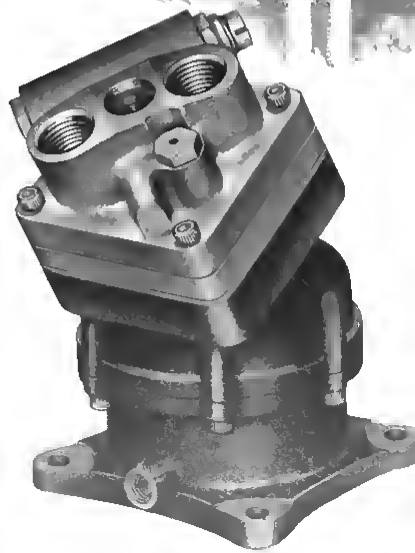

Variable Hydraulic Motors using the Advanced Design Series concept are now under development

AVIATION CALENDAR

Oct 26-28—First International Symposium on Gas Lubricated Bearings Washington, D C For information S W Dotoff Power Branch Office of Naval Research Washington 25, D C, Prof D D Fuller Franklin Institute Laboratories for R&D Philadelphia 3 Pa

Oct. 26-28—Sixth Annual East Coast Conference, Institute of Radio Engineers Professional Group for Aeronautical and Navigational Electronics Lord Baltimore Hotel Baltimore, Md (Some classified sessions sponsored by Air Research and Development Command)

Oct 26-30—National Conference, Society of Photographic Scientists & Engineers Edgewater Beach Hotel Chicago, Ill

Oct 28-29—Sixth Annual Computer Applications Symposium, Morrison Hotel Chicago Ill Sponsor Armour Research Foundation of Illinois Institute of Technology

Oct 28-30—Annual Industry Display, Aircraft Electrical Society Pan Pacific Auditorium, Los Angeles, Calif

Oct 29-30—Fifth Annual Electron Devices Meeting Institute of Radio Engineers Professional Group on Electron Devices Shoreham Hotel Washington D C

Nov 2-4—National Midwestern Meeting on New Frontiers in Aviation Institute of the Aeronautical Sciences, Hotel Lassen Wichita Kan

Nov 2-5—Fall Meeting Western States Section Combustion Institute Institute of the Aeronautical Sciences Bldg Los Angeles, Calif Subject Equilibria and Performance of High Temperature Systems

Nov 3-5—11th Annual Mid America Electronics Conference, Hotel Muehlebach Kansas City, Mo Sponsor Institute of Radio Engineers Kansas City Section

Nov 4-6—National Automatic Control Conference, Sheraton Hotel Dallas Tex

(Continued on page 6)

AVIATION WEEK Including Space Technology

October 19, 1959

Vol 71, No 16

[illegible] weekly with an additional issue in December by McGraw-Hill Publishing Company James H McGraw [illegible] Editor Executive Board panel below for directions regarding subscription or change of address Executive Editorial Circulation and Advertising Offices McGraw Hill Building 330 West 42nd Street New York 36 N Y Publication Offices 99 North Broadway Albany N Y Donald C McGraw President Joseph A Gerardi Executive Vice President L Keith Goodrich Vice President and Treasurer John J Cooke Secretary Officers of the Publications Division Nelson L Bond President Harry L Waddell Senior Vice President John H Callahan Vice President and Editorial Director Joseph H Allen Vice President and Director of Advertising Sales A R Venezian Vice President and Circulation Coordinator

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AVIATION CALENDAR

(Continued from page 5)

Sponsors Institute of Radio Engineers; American Institute of Electrical Engineers; Instrument Society of America; American Society of Mechanical Engineers. AIEE is conducting a parallel Control System Components Conference on Nov. 5-6.

Nov. 9-11—Fourth Instrumentation Conference and Exhibit. Biltmore Hotel, Atlanta, Ga. Sponsors Institute of Radio Engineers Professional Group on Instrumentation and the Atlanta Section.

Nov. 9-20—13th Annual Air Transportation. Institute, American University's School of Business Administration, Washington, D. C.

Nov. 11-13—16th National Meeting, Operations Research Society of America. Huntington-Sheraton Hotel, Pasadena, Calif.

Nov. 12-13—Quarterly Regional Meeting, Assn. of Local Transport Airlines. Marott Hotel, Indianapolis, Ind.

Nov. 16-19—14th Annual Meeting and Astronautical Exposition, American Rocket Society. Sheraton-Park Hotel, Washington, D. C.

Nov. 16-20—20th Annual Convention, National Aviation Trades Assn. Hotel Monteleone, New Orleans, La.

Nov. 17—Fall Meeting, Society of Aircraft Materials and Process Engineers, Eastern Division. Sheraton-Carlton Hotel, Washington, D. C.

Nov. 17-18—Technical Seminar, American Society of Tool Engineers. Sheraton Hotel, Philadelphia, Pa. Topic: Problems of Machining Space Age Metals.

Nov. 17-18—National Turbine Powered Air Transportation Meeting, Institute of the Aeronautical Sciences. Fairmont Hotel, San Francisco, Calif.

Nov. 17-19—34th Meeting, Aviation Distributors and Manufacturers Assn. Diplomat Hotel and Country Club, Hollywood, Fla.

Nov. 17-19—1959 Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers. Boston Commonwealth Armory, Boston, Mass.

Nov. 19-20—Seventh Annual Aircraft and Missile Division Conference, American Society for Quality Control. Sheraton-Dallas Hotel, Dallas, Tex.

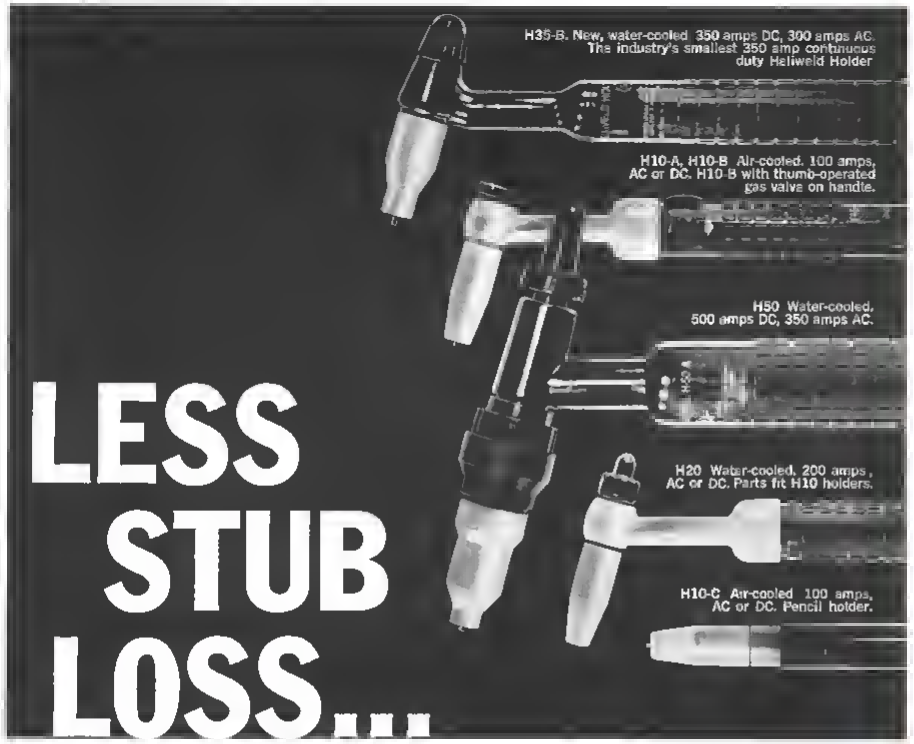
Nov. 23-24—Symposium on Solid Facts about Solid State. Instrument Society of American, Ben Franklin Hotel, Philadelphia, Pa.

Nov. 30-Dec. 4—Fourth Annual Naval Air Weapons Meet, Operation Top Gun. Marine Corps Auxiliary Air Station, Yuma, Ariz.

Nov. 30-Dec. 4—First industry and government-wide training course in Value Engineering & Analysis. Industrial Education Institute, Boston, Mass.

Dec. 1-3—Eastern Joint Computer Conference. Statler-Hilton Hotel, Boston, Mass. Sponsors: Institute of Radio Engineers, American Institute of Electrical Engineers, Assn. for Computing Machinery.

Dec. 7-8—Classified symposium on "The Plasma Sheath, Its Effect on Communication and Detection." Boston, Mass. Sponsor: Electronics Research Directorate, Air Force Cambridge Research Center.



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4. **EASIER HANDLING**—For easier handling try the new H35-B. You'll find it the standout holder for work in tight corners. All of the holders feature Airco's non-slip corncob handle. Weights are a mere 4 ozs. to 11 ozs.

Heliweld Economy Packs are available from your Authorized Airco Dealer. He's listed in the Yellow Pages under 'Welding Equipment and Supplies".

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PESCO SPECIALISTS DESIGN IN HI-TEMPERATURE HYDRAULIC PUMP FOR FAIL-SAFE OPERATION!

The environmental factors of supersonic performance necessitate new concepts of dependability in air weapon subsystems and components. To meet the requirement for fail-safe operation, PESCO engineers have created a new *dual-element high-temperature pump for main hydraulic systems*. This advanced design features two independent pumping elements housed in a single body and driven by a common shaft. Failure of either element does not effect over-all performance because *each is capable of meeting the system's flow requirements.*

This dual element design exemplifies Pesco's creative engineering capabilities for specialized high-temperature hydraulic pumps and motors. Precision units featuring fluid temperatures to 550°F and over-all efficiencies of 90% can be supplied to meet your specific requirements. *For details, call your nearest Pesco representative or write direct.*

Operating on 25 100 psig inlet press and 550°F inlet temp, this PESCO Dual Element Design discharges 21.5 gpm at 4000 psi.

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BORG-WARNER CORPORATION
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Creative Engineering for the Space Age

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high performance

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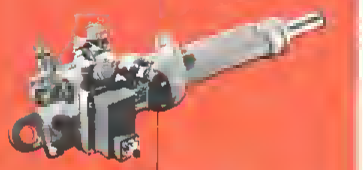

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(1) **On ICBM.** Controls rocket engine position. **First fully qualified control actuator.** Features extreme environment servo valve.

(2) **On IRBM.** For engine positioning. Features mechanical position feedback.

(3) **On newest interceptor.** Actuates control surfaces. Features dual hydraulic systems. Responds to manual or electrical commands.

(4) **On satellite** (final stage). Engine position control. Features cylinder snubbers, and load limiters.

Hydraulic Research **originator of the dry coil servo valve,** is thoroughly experienced in the servo and control field. Use this design background and proven production proficiency to your advantage. Write for further information.

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PRESSURE SWITCHES

GPL data handling

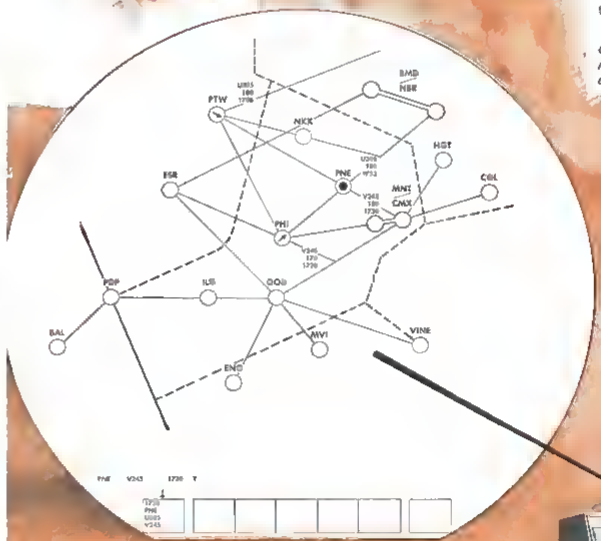
equipment for the Federal Aviation Agency

GPL's experience and ingenuity are at work assisting the FAA Bureau of Research and Development in the creation of a modern data processing central, the heart of tomorrow's air traffic control system. The central will receive up to 400 aircraft flight plans hourly, remember 1,000 such plans simultaneously and transmit 200 plans and 800 updates hourly to adjacent centers. Automatic processing and unique displays of such data will make significant contributions to the efficient control of aircraft in en-route transition and terminal areas.

The FAA data processing central is just one of a number of airborne and ground-based programs reflecting GPL's capabilities in the data handling field. These programs are supported by GPL's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPL organization is "systems oriented," offers complete capabilities ranging from research, engineering and manufacturing to customer service.

Why not put these broad capabilities to work on your problem?

GPL Avionic Division/airborne navigators/missile guidance/radar/airborne computers/data handling systems/communications equipment/infra red/closed circuit TV



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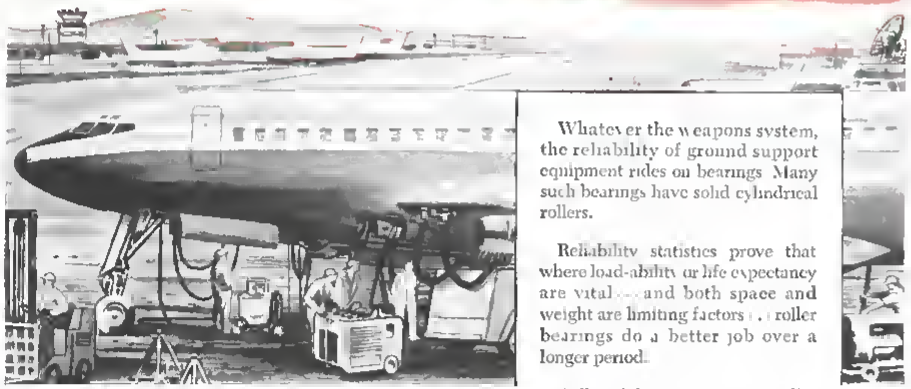
On the Ground as in the Air . . .

RELIABILITY rides on BEARINGS



Whatever the weapons system, the reliability of ground support equipment rides on bearings. Many such bearings have solid cylindrical rollers.

Reliability statistics prove that where load-ability or life expectancy are vital . . . and both space and weight are limiting factors . . . roller bearings do a better job over a longer period.

Rollway's long experience in roller bearings for military and commercial equipment is reflected in our new *Air-Rol* Data Book. It contains new and vital criteria for bearing selection. A letter on company stationery will bring it to any qualified person by return mail. Rollway Bearing Company, Syracuse, N. Y.

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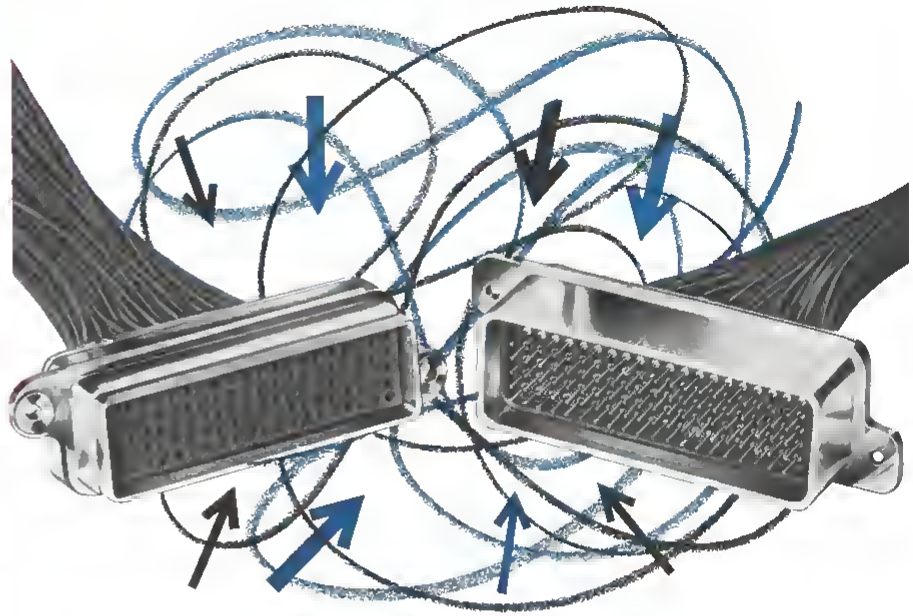
WHEN THE DUTY'S ROUGH AND THE CIRCUITS ARE CRITICAL



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Environmentally sealed or unsealed, *AMPin-cert* connectors are made in 50 and 100 position units and have a number of unusual features including: single or dual circuit leads per contact (in the 50 position unit) . . . crimp-on snap-in contacts with extra wire insulation support against vibration . . . aluminum shells for shock . . . cadmium plating for corrosion resistance . . extended alignment skirts plus alignment bushings on shells to prevent coupling damage to contacts . . . alpha-numerical coding of all cavities.

Get reliable performance under vibration and shock . . . in arid climates . . . in excessively humid conditions . . . in extreme cold or heat. No solder, naturally. Current rating of 5 amperes.

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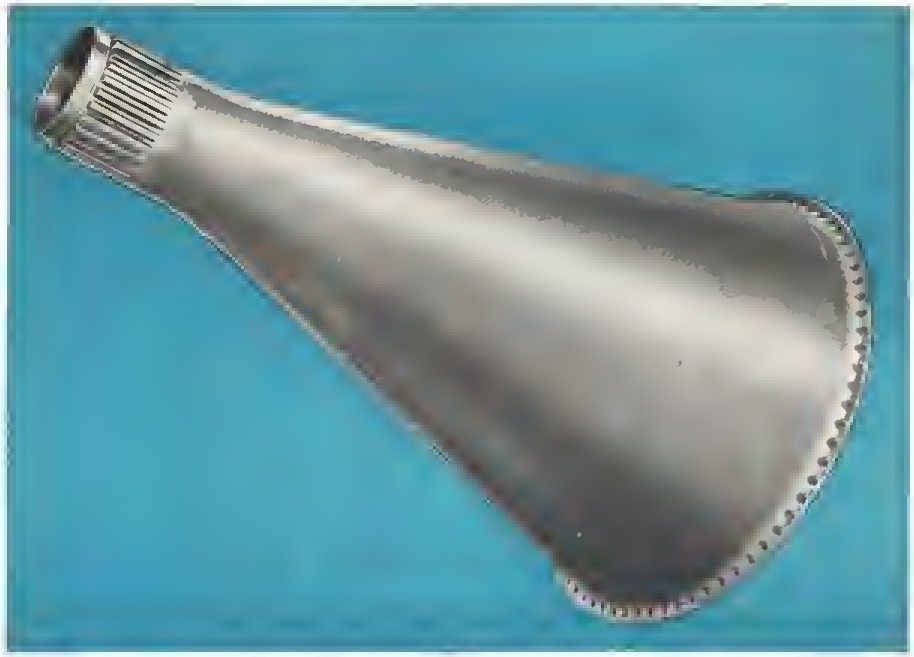

René 41 conical forging is 30" high, 26" O.D. at flange, forged from 510 lb. billet multiple. Offers tensile strength of over 100,000 psi at 1650° F.

How René 41* combines WORKABILITY with high strength in a conical forging for jets

Metallurgical Products Department reports on a super alloy—and on how its unique properties assure its role in supersonic metallurgy

General Electric's René 41 super-strong, high-temperature alloy offers many things to the aircraft and space-age industries. Take *workability*, for example.

This front conical turbine shaft for a jet engine is a forged, backward extrusion. The alloy requires excellent workability. And, because of the part it plays in the functioning of the engine, high strength at high temperatures is a must. The answer, René 41 alloy!

Made by the General Electric vacuum-induction-melting process, René 41 is virtually free from impurities, can be successfully forged, welded, or formed. With greater tensile and stress rupture strengths, René 41 permits higher operating temperatures, provides increased engine efficiency in jet aircraft. No alloy with comparable mechanical properties can approach the workability of René 41!

Got a design problem? Choose from General Electric's variety of high-purity, vacuum-melted alloys in sheets, bars, billets, wire, or castings. For detailed information—or the assistance of one of our engineers—write today to: *Metallurgical Products Department of General Electric Company, 11107 E. 8 Mile Ave., Detroit 32, Michigan.*

*René 41 is a trademark of the General Electric Company

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Forms Airtight Weather-Proof Enclosure

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In the F-102 and F-106* canopies, for example, engineers at Convair Division of General Dynamics (San Diego), specified that the windows be "floated" in Silastic RTV. This window seal maintains cockpit pressure but resists cracking and checking and other effects of weathering and ozone. It remains pliant in spite of stratospheric cold.

And Silastic RTV seals are easy to form. Semi-fluid in nature, the RTV can be applied by caulking gun directly to the spot you want sealed. In a short time (you can vary the time from a few minutes to a whole day) the fluid sets up to a rubbery solid, and you have a seal with tolerances to ± zero. Other uses of Silastic RTV, aside from caulking and sealing, include potting of electronic gear and making of molds for prototype parts. Various consistencies are available for application methods other than caulking gun. For further information on this product, send for literature: "How To Use Silastic RTV." Address Dept. 0922.

*ST GWN F-106 DELTA DART

TYPICAL PROPERTIES OF SILASTIC RTV SYSTEMS

After Vulcanizing (24 hours at 77 F)	Fluid Grade	Caulking and Putty Grade
Hardness, Shore A	30 to 65	20 to 55
Tensile Strength, psi	250 to 850	225 to 450
Elongation, percent	100 to 250	120 to 400
Brittle Point, degrees F	—100	—178 to —100
Shrink, linear, percent		
after 3 days* at 77 F	0.6	—
after 6 days* at 77 F	0.8	3.2 to 1.6
after 14 days* at 77 F	1.1	—
Water Absorption, percent after 70 hours immersion at 212 F	1.0	7.0
Working Time	10 min. to 3 hr.	2 to 5 hr.

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Propulsion through the ages . . .

The Eole of Clement Ader's flight of 1889

An astounding proposal through the air on bat-like wings adjusted by a series of wheels and pulleys operated from the cockpit powered by a 20 h p steam engine turning a single four-blade propeller Such was the "Eole" of 1889, designed and built by Clement Ader The gallant French aeriel pioneer attempted actual flight in October of 1890 and claimed success, though the unromantic considered his "hop" little more than a free fall broken by the feeble cranking of the airscrew Nonetheless, Ader was clever, brave and persistent, and added the word "aeroplane" to the French language What wonderful craft he might have designed if today's flight components were available to him — Rotol propellers, for example Rotol designed, developed and produced the propellers for the first turbo-prop aircraft to fly, and currently supplies turbo props to more than 100 airline and aircraft operators throughout the world who attest to Rotol reliability These turbo-props are standard equipment on the Vickers Viscount, Fairchild F-27, Grumman Gulfstream and Fairey Rotodyne

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The world's most experienced manufacturers of turbo-propellers — over 6,000,000 hours of flying time.

Rotol Incorporated after-sales service throughout the United States provides immediate spare parts delivery, technical service on propeller operations and applications.

For information on Rotol products and after sales service call Rotol Incorporated, 409 Jefferson Davis Highway Arlington 2, Virginia Phone OTis 4-6290

dead center

Kelsey-Hayes thrust vectoring systems give missiles proper directional control

Kelsey-Hayes is contributing substantially to the design, development and production of new thrust vector control systems for solid fuel propulsion.

For example Kelsey-Hayes, in a recent crash program, designed and fabricated a movable nozzle control that passed static firing tests for one of the newest sophisticated missile systems.

The swivel nozzle control is just one of the latest developments by Kelsey-Hayes as a subcontractor of propulsion subsystems, flight componentry and high performance materials. Spearheading Kelsey-Hayes activities is the Advanced Design Group, a flexible team of experienced design specialists. Kelsey-Hayes Company, Detroit 32, Michigan.

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COVER—Atlas 18-D rises from Cape Canaveral launch pad in first test of new Mk. 3 nose cone (AW Oct. 12, p. 30). Mk. 3 is the first Air Force re-entry vehicle to use ablating technique, in which lightweight materials dissipate heat by vaporizing directly from the solid state.

PICTURE CREDITS

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Transition in Tokyo

The crisp, sunny days during the fifteenth annual general meeting of the International Air Transport Assn. and the blazing whirl of colored neon signs that turns downtown Tokyo into a nocturnal rainbow may already be fading from the minds of delegates now scattering around the world to their homelands. But two memories will remain for a long time to come in the hearts and minds of all those attending this historic session.

The first is the gentle, warm and truly magnificent hospitality extended by the official host, Japan Air Lines, through its president, Seijiro Yanagita. The second is the unmistakable feeling that this meeting is a historic milestone in the transition of international airline business into a new technical and economic era.

This feeling of transition included both internal IATA affairs, where younger heads of member airlines are rebelling against domination by the IATA staff and the unchanging faces of the executive committee, which is confined primarily to large airlines and senior statesmen types, and the external impact on the air transport industry of the technical effects of jet operations plus a new approach to economics which this makes vital for survival.

Nobody could come away from the IATA Tokyo meeting without the firm conviction that the basic character of the airline business is changing radically and that these changes are coming faster than most airline executives realize or will admit. Indicative of the feeling of younger, more aggressive airline executives regarding the future issues of their business was the address of retiring IATA president J. R. D. Tata, chairman of Air India International, who injected a humorous note and incisive comments that were indeed refreshing in proceedings that have become overstuffed with pomposity.

Major Issues

Mr. Tata spoke squarely on most major issues facing this IATA meeting. His remarks on the fare issue certainly reflected the majority opinion of the Hawaiian traffic conference that lower fares are inevitably coming but that it would be prudent to adjust them downward in line with the economic realities of the geographic regions involved. He also made passing reference to the variety of IATA members, ranging from high cost, heavily-subsidized government corporations to those "recognized as being as lean and aggressively efficient as any transport operator in the world." The significance of this reference did not pass unnoticed by veterans of the Hawaiian fare battles.

Mr. Tata also emphasized that even these "lean and aggressively efficient" airlines were having difficulty in making anything but extremely thin profit margins from current operations. However, Mr. Tata made it clear that lower fares must be a future characteristic of the international airline industry and can be achieved through "coordinated efforts among the carriers and aircraft and engine manufacturers." Such efforts, Mr. Tata said, should be aimed primarily at reducing fuel consumption and maintenance costs, increasing the life and utilization of flying equipment, pooling resources to minimize duplication expenditures and, wherever possible, avoiding the highly wasteful excess capacity offered today on many world air routes.

This technique, pioneered by the European Air Union, in pooling the resources of a combination of smaller airlines to finance, operate and maintain jet transports, is a major future trend in international airline business and will basically change the character of corporate structures and nationalistic policies during the next decade. For, as the advent of multi million-dollar, fuel-gulping subsonic jet transports has forced this pattern of regional pooling for gas turbine operations among the smaller carriers, so will the advent of supersonic jet transports force similar arrangements on even the biggest globe-girdling giants in IATA today.

Mr. Tata also faced the problem of supersonic jet transports with that combination of optimism flavored with realism that is required to stay competitive in this business. He noted that the prospects of traveling 2,000 mph. would bring such immense benefits to mankind in promoting trade, travel and communications that "in my view nothing should be done to discourage or retard such a phenomenal step forward."

At this session, the IATA technical committee headed by Sanford Kauffman, of Pan American, took the first historic step to realistically study the technical problems of supersonic transports to be ready for their operational advent a decade hence. It is worth noting that IATA technical studies of subsonic jet transports began just a decade ago and, although many technical operational problems with this type aircraft are still not universally solved, this patient, detailed work over the past 10 years laid the foundation for the success of initial jet airline operations across the North Atlantic and on key globe-girdling routes.

Supersonic Tronsport Future

Another indelible impression remaining with those attending the IATA Tokyo meeting is what a tremendous postwar impact air transport has had on the Pacific basin and what a revolutionary effect jet transports will have in shrinking the vast expanse of the Pacific area and whittling stage length times between major cities. Most delegates traveled from 6,000 to 8,000 mi. to attend this meeting, a feat impossible without the old-fashioned piston-powered air transport. Already, the Boeing jets of Pan American and Qantas are cutting these travel times in half to a point where Tokyo is as close in travel time to California as was Hawaii in the DC-4 era.

Mr. Yanagita made an eloquent plea to IATA delegates to understand the significance this new role of air transport has for the Pacific basin in bolstering economic, cultural and political ramparts of free Asia and casting aside the insular isolation of the Asian peoples, in the past, fostered by the long, difficult communications with other economic areas. "Today East is West and West is East and no man can say where one actually begins and the other ends."

And so the fifteenth IATA general meeting has been unusually profitable in illuminating the future trends of the international airline business for those who care to see: continued reduction of fares in relation to lowered operational costs and the size of the potential traffic pools to be tapped; regional pool operators of jet equipment in Europe, Africa and Asia plus the Commonwealth bloc, a change in airline attitude on supersonic jet transport from "if" to "when" and the laying of the first technical foundation for its introduction; and, finally, a clear vision of the vital role the jet transport will play in the vast Pacific area. Truly it was a memorable meeting.

—Robert Hotz

WHO'S WHERE

In the Front Office

Hubert A. Schneider, vice president and general counsel and a director of Pan American World Airways, Inc., succeeding **Henry J. Friendly**, who is now a U. S. Court of Appeals judge.

James S. Laidlaw, vice president and general manager, Ilyon Mfg. Co., Pasadena, Calif., succeeding **William T. Snebold**, resigned. Mr. Snebold continues as a director. **Edmund W. Baker** succeeds Mr. Laidlaw as vice president-engineering and chief engineer.

Dr. Robert E. Beam, vice president-research and development, Hallicrafters Co., Chicago, Ill. Dr. Beam is professor of electrical engineering at Northwestern University.

John H. Mahoney, vice president-marketing services, Capital Airlines, Inc.

Hershel Toomim, president, Solidtronics Corp., Panorama City, Calif., a newly established division of Fleetrasolids Corp.

Jules M. Kleinman, president and director of engineering, Mini-Rad, Inc., North Hollywood, Calif.

George A. Strichman, president, Kellogg Switchboard and Supply Co., Chicago, Ill., a division of International Telephone and Telegraph Corp.

Alanson W. Parkes, Jr., president, Boonton Laboratories, Inc., Boonton, N. J. Also, **Frank Zavac**, executive vice president and general manager.

Benjamin H. Ciseel, senior vice president and director, Electronic Specialty Co., Los Angeles, Calif. **Rollin M. Russell** succeeds Mr. Ciseel as executive vice president and director. Also, **Dr. James A. Marsh** and **Richard H. DeLano**, directors. Dr. Marsh is president and Mr. Delano executive vice president of Systems Laboratories Corp., recently acquired by Electronic Specialty Co.

Edwin R. Gamson, vice president, Telemeter Magnetics, Inc., Los Angeles. Mr. Gamson is general manager of the Components Division.

B. P. Gibbons, vice president-sales, Alta-mil Corp., El Segundo, Calif.

Noah Dietrich, board chairman, Houston Fearless Corp., Los Angeles, succeeding **Richard Woike**, who continues as a director and chairman of the executive committee.

Honors and Elections

The American Society for Metals has named **John L. Atwood**, president of North American Aviation, Inc., recipient of the society's Medal for the Advancement of Research. Under Mr. Atwood's leadership North American has led in the development of chemical milling and electrochemical milling, and pioneered in the use of titanium and in such advanced forming methods as explosive forming, the Society said.

K. E. Van Every, chief of the aerodynamics section of Douglas' El Segundo Division, has been awarded the Society of Automotive Engineers' Wright Brothers Medal for his engineering report, "Design Problems of Very High Speed Flight."

(Continued on page 150)

INDUSTRY OBSERVER

(The following Industry Observer column was compiled and written by the Aviation Week editorial team covering last week's triennial inspection of National Aeronautics and Space Administration's Langley, Va., Research Center.)

▶ National Aeronautics and Space Administration's Project Mercury pilots have made substantial changes in the original layout of the Mercury capsule instrument panel, which is now close to final configuration. Power limitations of the capsule's battery system will keep instruments relatively simple and barren of cathode ray tube displays and other sophisticated approaches developed in the various integrated instrumental panel programs.

▶ Power and weight limitations have dictated elimination of one of the earth sky cameras planned for the Mercury capsule, but the pilot will have one multi-purpose camera he can operate manually. Doctors insist upon including a camera for a closeup record of the pilot's facial reactions in addition to the camera carried to record instrument panel readings. Mercury pilots are gradually acquiring the technique of controlling the capsule with the three-axis sidearm controller, but the feeling persists that NASA should continue to study the advisability of restoring yaw control to the foot pedals common to aircraft. Use of foot pedals probably would increase capability for simultaneous control motions and reduce chances of cross-coupling in control motions.

▶ Escape system on the Mercury capsule is triggered by pressing an unlocking button and moving a sidearm control stick held in the pilot's left hand.

▶ National Aeronautics and Space Administration's Goddard Space Flight Center is preparing a sounding rocket payload with optical sensors to study the unexplained ultraviolet nebulae discovered two years ago by sounding rockets launched to measure brightness of the stars in the far ultraviolet portions of the spectrum. Payload will be launched from Wallops Station, Va., this winter with an Aerobee-Hi rocket.

▶ Scout space research rocket is now expected to be flight-tested at NASA's Wallops Station late this year. Delta vehicle, which is a modified Thor Able, is expected to get its first flight test at about the same time at the Air Force Missile Test Center, Cape Canaveral, Fla.

▶ Moulding of an individually-fitted couch for a Mercury capsule pilot requires him to lie on his back for two hours in a bed of quick-hardening sand. Nitrogen is forced through the sand under pressure to speed hardening.

▶ Argon-atmosphere fusion welding process is used to join inner and outer skins of the Mercury capsule and for a number of other applications in capsule construction. Inner skin is built up with stringers and bulkhead rings. Outer skin or radiation shield attaches to these stringers.

▶ Jettisoning of antenna housing lid and deployment of drogue parachute on the Mercury capsule are both accomplished with explosive charges. After the drogue chute has stabilized the capsule, the antenna canister is separated from the main body of the capsule, pulling out the main parachute. In capsule tests using the Little Joe booster, the main parachute is deployed above 1,000 ft. altitude. A backup chute could be used if first one failed.

▶ Mercury pilots now have the use of four aircraft with which to maintain their flying proficiency while they train for their orbital missions. In addition to two Lockheed T-33s, they now have two Convair F-102s from which the armament has been stripped. F-102s are assigned to National Aeronautics and Space Administration by USAF and maintained by an Air Force unit at Langley AFB, Va.

▶ NASA has selected a frequency of 2,400 mc. for its passive communication satellite tests. Industry and private experimenters will soon be given full technical details in an effort to encourage them to participate in passive communication satellite tests on a voluntary basis.

Washington Roundup

Curtiss-Wright Quits AIA

Curtiss-Wright Corp. announced its resignation last week from the Aerospace Industries Assn. and the Manufacturers Aircraft Assn. touching off a mild controversy between Roy T. Hurley, Curtiss Wright president, and Orval R. Cook, president of AIA.

Hurley declared that he has become convinced that "the defense of our country, as well as the welfare of taxpayers and stockholders, will be better served if each company operates independently in as many areas as it can afford or has the qualifications to do so. By so doing we can compete more successfully in world affairs and minimize the inflationary effects of a large defense program."

Cook retorted that he regretted Curtiss Wright's resignation and added: "Under prevailing complex conditions, our members believe there are many areas, and especially in the technical fields in which group action is necessary both to the defense establishment and to industry."

Cook said he had expected the Curtiss Wright resignation and noted that "it had increasing interests in fields other than those served by our association."

Hurley, on the other hand, emphasized that Curtiss-Wright is not withdrawing from the aviation industry. "On the contrary," he said, "we feel that a program of independent action on our part will provide a stimulus that the industry needs at this time."

Decision Delay Rapped

Defense Department delay in closing production facilities at two new boron fuel plants (AW Aug. 17, p. 26) was sharply criticized in a report issued by the House Science and Astronautics Committee staff.

The report agreed that the services were justified in terminating programed production at the two five-ton a day plants at Muskogee, Okla., and Buffalo, N. Y., but charged that the Defense Department was slow in recognizing changing defense requirements and that, as a result, total costs of the program were substantially increased. Blame for the delay, it said, rests on "the whole cumbersome process of decision making progress in the Department."

Technology and Politics

Science and technology will enter the 1960 national election campaign as major planks in the platforms of both Republican and Democratic parties. Outlook is that the emphasis will be placed on their ability to ensure "peace" and promote an ever rising "high standard of living."

The Republican National Committee, in a 15-page report recently drafted by its "task force on science and technology," mentions the research and development work needed to sustain the nation's military stature only incidentally. The group is headed by Charles H. Percy, president of Bell and Howell, manufacturer of movie cameras.

The Democratic National Committee, in a report by its 17-member "science and technology committee," emphasizes as its first proposal the need for the establishment of a new independent agency to study the complex technical problems involved in disarmament. Dr. Ernest Pollard, head of the Biophysics Department of Yale University and chairman of the group, said the agency would act as a laboratory for the active study by "first class" scientists of problems such as the detection of atomic explosions with seismographs or reconnaissance satellites.

ALPA Endorses Rodor Plon

Air Line Pilots Assn. last week urged adoption of a Federal Aviation Agency proposal to require airborne weather radar on all scheduled four-engine airliners but said the proposal should be expanded to include all scheduled airline aircraft carrying passengers or cargo. The airlines already have voiced strong opposition to the FAA plan (AW Oct. 12, p. 47).

Suggested amendment submitted to FAA by the pilots' union would make radar use mandatory on all aircraft weighing in excess of 12,500 lb., including the Douglas DC-3 which make up the bulk of the local service airlines fleet and which would be excluded in the FAA proposal as it now stands.

Declaring that it has urged such action for many years, ALPA said an evaluation of the radar units by pilot members indicates the use of radar has improved both the safety and efficiency of operations in areas of suspected turbulence, heavy rain and hail. To substantiate its position, ALPA submitted a list of 59 aircraft accidents involving both twin- and four-engine aircraft over a period of seven years in which turbulence was suspected as being a factor.

The Air Transport Assn., in its reply to the FAA proposal, questioned the basic need for a mandatory regulation and said that, if adopted, the plan could inflict serious operational and economic hardships on the airlines. The FAA action was touched off by a Capital Airlines Viscount turboprop accident near Baltimore in May which appeared to have resulted from the aircraft entering an area of turbulence with its radar inoperative (AW May 18, p. 41).

Khrushchev's Helicopter

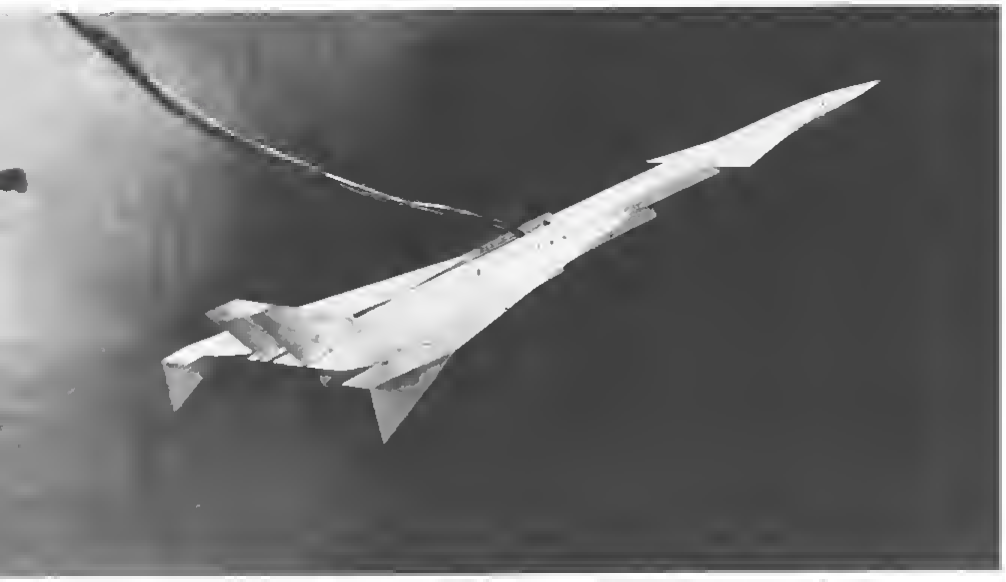
United Aircraft Export Corp. now is calculating the costs of all the trimmings and trappings that will be needed to make a Sikorsky S-58 helicopter identical with the one used by President Eisenhower to fit the desires of Soviet Premier Nikita Khrushchev. Khrushchev rode the President's aircraft during his recent U. S. visit, despite the warnings of Soviet advisers that helicopters are not very safe, admired it, and commented, "I'd like to buy one." The Soviet Embassy promptly took the matter up with the State Department, and opened negotiations for the purchase of three S-58s with United Aircraft (AW Oct. 12, p. 39). United, however, could not immediately set an export sales price for a specially equipped helicopter such as the one used by the President.

Spoce Strategy Reveoled

There is this sign on a Pentagon bulletin board:

"Although Soviet Russia leads the U. S. in rocket propulsion the U. S. maintains its lead in such vital areas as miniaturization. Otherwise, it could not have succeeded in building a space program so much smaller than the one Russia has."

—Washington staff



MODEL based on an early configuration of the North American B-70 Mach 3 bomber being tested for dynamic stability and control characteristics indicates wing planform for the airplane. Note the folding wingtips (AW Sept. 7, p. 35). Model is 1/20th scale.

Space Technology

NASA Probes Manned Re-entry Designs

JET-FLAP canard configuration is tested with free flight model. Jet exhaust is deflected upward by tailpipe extensions against wing and flap to increase lift greatly.

Langley Field, Va.—Problems of manned flight continue to dominate the research pattern of the National Aeronautics and Space Administration although emphasis has shifted sharply from atmospheric flight toward space applications during the past year.

This shift was clearly evident last week at the 1959 inspection of NASA's Langley Research Center, the first public tour of an NASA laboratory held since the agency was created a year ago. Langley was the oldest of the three laboratories acquired from the predecessor National Advisory Committee for Aeronautics.

Marked reorientation towards space projects has dramatically broadened the spectrum of environments and conditions involved in manned flight research, which now extends from ground effect and VTOL machines through hypersonic transports and orbital flight to interplanetary travel.

Although the Project Mercury man-in-space program is the best known of the manned flight programs, NASA also is investigating a number of other forms of re-entry and space vehicles as well as the power and communications problems associated with them.

Manned re-entry vehicles are receiving strong attention from NASA, and a wide variety of designs are under study. Operational usefulness of each basic design depends upon the successful development of new high temperature structural techniques as well as aerodynamic behavior of the designs in all flight regimes from hypersonic through subsonic. A combination of those configurations may prove most desirable since some have great flexibility in their application.

Re-entry Designs

Basic designs under consideration are:

- **Inflatable vehicles** with very large wing areas, providing wing loading of possibly one pound per square foot.
- **Collapsible wings** resembling kites which are stored in small cylinders during launch and are extended for flight in the upper atmosphere.
- **Variable geometry vehicles** with triangular planforms which re-enter the atmosphere at a 90 deg. angle of attack. Horizontal control surfaces are folded onto the back of the aircraft during the maximum heating period and extended for low speed flight when the nose is lowered to conventional angles of attack.
- **High-performance gliders** with high lift to drag ratios resembling current delta wing aircraft.
- **Gliders with highly rounded leading** edges to reduce local heating but gen-

DRAG REDUCTION for a Mach 2.3 transport utilizes area rule fuselage and engine nacelles mounted at rear of the wing to create bulges (AW July 14, 1958, p. 49). NASA's Richard T. Whitcomb, who discovered the area rule and later modified it to transports, is shown with a 6-engine model in Langley's 8-ft. transonic tunnel.

KITE-LIKE structure which might be used as an auxiliary wing to reduce landing speeds of supersonic transports would be collapsed and stored in compartment on top of the aircraft.

STORABLE 6 000 lb thrust liquid rocket (full size cutaway at left) will be third stage of Vega rocket vehicle. Flight package of a 100 ft sphere is at right. NASA would launch sphere as a relatively small package that would inflate automatically in space

crally similar to the one described above. These may prove to have more operational flexibility and range in high heating situations.

- **Modification of Mercury-type ballistic capsules with flat tops that can develop some lift.**
- **North American X-15 research vehicle which is under continuing study for possible use at much higher speeds than specified in the original design.**

Inflatable and collapsible aircraft would alleviate two main problems of orbital vehicles, one at great altitude and one at launching. There is a stability problem at launch that comes from placing a large rigid structure with wings on top of a slender ballistic missile which would be eliminated if the wings could be collapsed. High altitude performance of a re-entry vehicle would be greatly increased as would the performance of any aircraft if the wing loading could be lowered to one or two pounds per square foot. NASA believes that this may be achieved with inflatable wings.

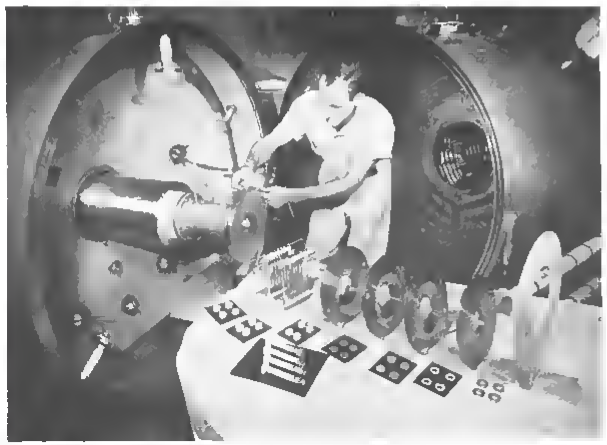
A 10 000 lb re-entry glider for instance, would have a wing area of 5,000 to 10,000 sq. ft. and could begin to slow down somewhere near 300,000 ft. altitude with its aerodynamic heating greatly reduced. The structural material of the inflatable glider would be much less resistant to heat however than a solid structure. Significant progress already has been made with inflatable structures and with their stiffness and resistance to flutter and with their capacity to withstand moderate heating. The present opinion is that such structures could be used for very high altitude re-entry.

The collapsible vehicle models demonstrated by NASA had three stiff poles in the streamwise direction with flexible material connecting them. They resembled kites when the flexible material ballooned out and provided a lift-producing curved surface. Similar kites might be used to increase the lift of orbital vehicles during landing as well as re-entry phases of the flight.

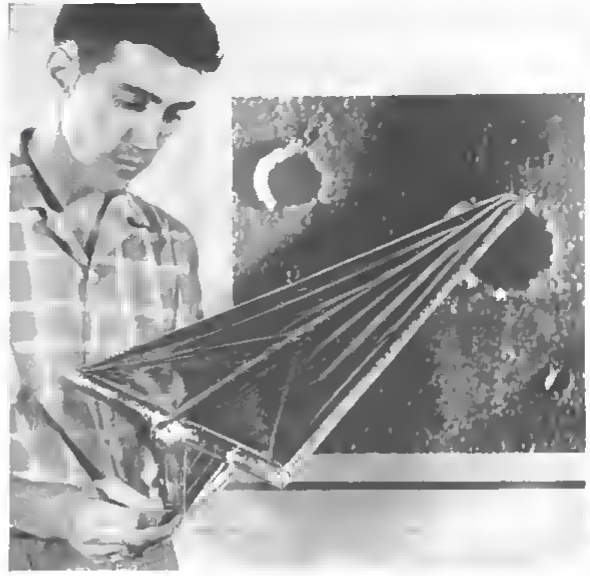
Variable geometry vehicles of solid construction which would retract large control surfaces out of the main floor during re-entry also are being considered by NASA. Landing would be greatly aided when these surfaces are extended but during the hypersonic speed range when they traveled at very large angles of attack, they would have many of the characteristics of a ballistic capsule.

Success of the research work on high strength heat-resistant and cooled structures will eventually determine whether these vehicles will be needed. If this research effort produces usable results rapidly, the first winged re-entry vehicle probably will resemble modern fighters. NASA has constructed large scale structural models of hypersonic gliders which probably will be satisfactory for re-entry heating periods up to 20 min. Many expansion joints, insulating layers and structural members filled with water are typical features of these structures which can withstand maximum outer surface temperatures of 2,500°F and 1,200°F on the load-carrying members.

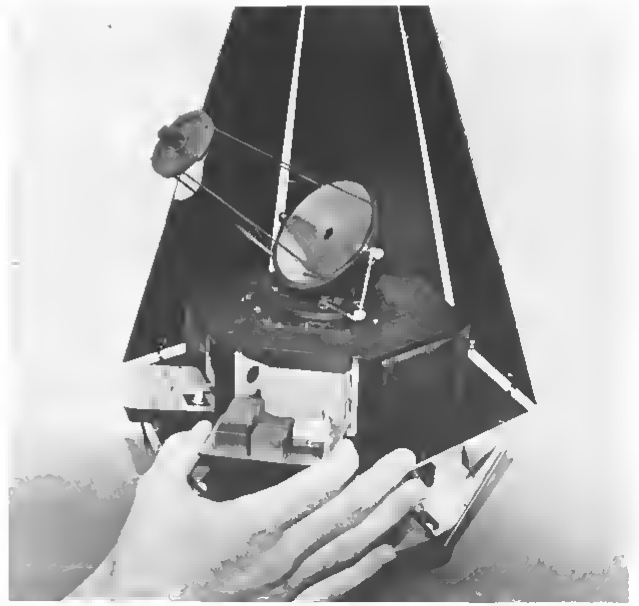
The wing leading edges are the main problem today, with their temperatures going above 3,000°F. Refractory members, graphite ceramics and ablating materials are being considered for this use. The bluntness of the leading edge



RESEARCH MODEL of ion engine that operates with cesium as a propellant is assembled at NASA's High Vacuum Test Facility at Lewis Research Center, Cleveland, Ohio



PROPOSED foldable space vehicle (model at left) would be made of thin layers of aluminum foil and plastic film to obtain data on penetration damage of micrometeorites. Full-scale plastic model of rocket motor (right) is tested for stability in wind tunnel



ONE-SIXTH scale model of proposed Mars payload for Vega vehicle has six avionic chassis on hexagonal base. Two chassis are shown opened, below infrared spectrophotometer

will be a direct indication of the structural engineer's success in his research. If he is very successful, the leading edges can be nearly as sharp as those on supersonic fighters and still withstand re-entry heating and land well. In this case, it will not be necessary to think of inflatable vehicles. The blunter the leading edges of re-entry gliders must be to withstand the heat, the more attractive variable geometry, collapsible and inflatable vehicles become.

National Aeronautics and Space Administration's 1959 inspection tour of its Langley, Va., Research Center was covered by an Aviation Week team of space technology editors Evert Clark and Craig Lewis and engineering editor J. S. Butz, Jr.

Space Propulsion

Space propulsion systems of the three basic types—electrical, nuclear and chemical—are now being studied under NASA programs. Electrical systems such as ion and plasma engines using nuclear reactors for power have generally appeared to be more economical than chemical rockets for trips beyond the moon. This conclusion, however, has been opened for re-evalution following the discovery of the great radiation belts around the earth. In the past, shielding weight on the electrical vehicles was proposed to be kept to a minimum by placing the nuclear reactor 100 ft. or more from the crew and using a shadow shield.

Now, heavy all-around shields would have to be used to protect the crew and vital equipment as the vehicle accelerated for many days through the radiation belts near the earth in order to build up the necessary velocity for interplanetary flight. This added weight might destroy the economic advantage of the electrical space vehicle.

Lifting it to high orbit above the earth before beginning its interplanetary trip also would affect the electrical vehicle's advantage over a rapidly accelerating chemical rocket that could leave a low orbit and pass quickly through the radiation belts.

Research into the basic fundamentals of controlling a high temperature plasma has assumed major prominence at NASA as it has in most research organizations interested in space propulsion and communications. NASA has added a new name to the lengthy list which already exists to describe this new branch of physics. The space agency calls it magnetoplasmadynamics in contrast to magnetohydrodynamics, plasma dynamics etc. which are used in other quarters.

Nomenclature for this new science appears to be evolving around the mathematical approach used and the broad problem being investigated.

One development of unusual interest in the NASA program is a propulsion device which accelerates a plasma with microwaves. A resonance set up in a microwave channel partially filled with plasma creates a powerful force which expels the plasma at great speeds. Exhaust velocities of 25 million mph. are considered possible with this device.

Production of radio-frequency radiation by firing bursts of plasma together also is being studied by NASA. Very strong signals with a low noise level have been demonstrated with this procedure. A new method of space communication of unprecedented power is believed possible using plasma amplifiers and signal generators.

The plasma sheath that surrounds bodies re-entering the atmosphere at great speeds is being investigated by NASA with a unique rocket system and ground-based plasma jets to determine just how this sheath changes the radar target and cuts transmission of radio signals from the re-entry body and how use of different materials may affect the density of the sheath.

Understanding of this phenomenon is important in missile warhead and decoy detection and tracking, and it becomes increasingly important as velocity of the body increases as it will with re-entering satellites and particularly with vehicles re-entering from interplanetary missions.

Six-Stage Rocket

NASA already has made exploratory flight tests with an inexpensive six-stage solid rocket fired from Wallops Station. First three stages lift the last three—which are called the velocity package—to altitude. It is stabilized in the normal attitude, still pointing upward. There the three final stages then fire downward through an open tube. The final stage is a spherical rocket motor developed by NASA, which serves as the re-entry body and comes in at satellite speeds. It has been photographed and signal attenuation from an antenna on its nose has been recorded. Massachusetts Institute of Technology's Lincoln Laboratories will assist in future studies.

The same antenna used in rocket flights is bathed in a plasma in an outdoor ground installation to study transmission under simulated conditions. Flight test experiments and theory agree, and NASA hopes that application of relatively simple theoretical approaches will bring understanding of the complex transmission problems.

Directly related is the use of heat protection materials. These must be studied experimentally to determine their effect on the intensity of the ionization. The NASA Scout vehicle, due for testing soon (see p. 23), will fire ablating noses at satellite re-entry and planetary re-entry speeds. Noses will carry ablation sensors to study this problem. While transpiration cooling using some gas such as helium increases in effectiveness with an increase in velocity, it carries weight penalties, and NASA says ablating materials now appear the most promising. Heat sink noses begin to decrease in effectiveness somewhat before 10,000 mph. and are not being considered for extremely high speed ranges.

RESTRAINT HARNESS is attached to couch for a Project Mercury capsule. Contoured couch is fabricated of foam plastic, finished with fiber material after hardening.

Experimental facilities still are entirely inadequate for reproducing re-entry flight velocities making the Scout tests essential, NASA says.

An immediate need exists for surveys to determine the size, energy and distribution of particles in space and for a theory to explain thoroughly the stresses and shock waves produced by high speed impact of space debris with space vehicles, according to NASA researchers.

Satellite and space probe flights are being supplemented in the laboratory, primarily with particle accelerators and light gas guns, at both Ames and Langley Research Centers.

Particles as small as atoms and ions traveling at speeds up to 2 million mph., can erode reflective surfaces of a space vehicle enough to allow a change in internal temperature that would affect operation of the instrumentation. For short-life satellites, this appears to be no problem, but further exploration is needed to prepare for longer space missions.

Even though their size alone would not present a problem, small meteoroids are hazardous because they travel at speeds from 25,000 to 160,000 mph., and produce explosive cratering effects. Crew compartments, propulsion systems and the large radiators expected to be used on nuclear and nuclear-electric manned interplanetary vehicles are particularly vulnerable. Impact also will be important to the inflatable manned vehicles now being considered by NASA. The Explorer VI satellite has recorded one or two impacts per day on two small plates, indicating that a vehicle large enough to carry a man would receive hundreds of impacts over a 24-hr. period.

NASA has learned that the shielding effectiveness of a piece of satellite shell of given thickness and weight can be greatly increased by dividing it and spacing the layers and by filling the space with a light material that can double as an insulator. Wide spacing permits resistance to particles of almost double the former velocity. Wide spacing, with glass wool sandwiched between, allows resistance to particles of almost three times the speed that the skin would withstand if it remained in a single piece.

Highest speeds reached thus far by NASA with light gas guns that accelerate material particles is 14,000 mph. Other researchers are exploring impact phenomena (AW Sept. 14, p. 108) but there is still disagreement, even between the Ames and Langley laboratories, over impact theory.

The Vega space vehicle will make the first use of a unique "parking orbit" technique to overcome the unfavorable location of existing launching sites. This will permit firing toward the moon at any time of the month and a 20% increase in payload.

NASA Fires First Little Joe Booster

First Little Joe booster to be fired in the Project Mercury development program is launched at NASA's Wallops Station, Va. Firing was an operational test of the booster, launching and destruct systems. Boilerplate capsule with mert escape rocket system was not instrumented. The 55-ft., 20-ton booster has an initial thrust of 250,000 lb.

First stage fires and drops away. Second stage fires, putting itself and the third stage and payload into an orbit around the earth and becoming a mobile launching base or temporary space platform from which the third stage can fire.

When the whole assembly is in the proper location and correctly oriented, the third stage fires toward the moon or other space target. If the vehicle were launched from Cape Canaveral, it would not quite complete one orbit of the earth before the third stage fired over Woomera, Australia.

Guidance for the Vega is a modification of an all-inertial Army missile system. In the three-stage version, it will ride above the third stage propellant tanks and will control flight of all three stages.

The third stage, being developed by NASA's Jet Propulsion Laboratory, is 27 ft. long. Hypergolic nitrogen tetroxide oxidizer and hydrazine fuel are fed by a simple cold helium pressurization system to the combustion chamber, which is regeneratively cooled by the hydrazine. Engine is made of spun and drawn stainless steel tubing and produces 6,000 lb. thrust. Second stage engine is the General Electric 405H-2, which is a modified Vanguard engine using Atlas tank components for its propellants. The Convair Atlas forms the vehicle's first stage.

Missions now proposed for the vehicle include 24,000-mi. orbits for meteorological satellites, 1,000-lb. payload lunar passes and lunar orbiting flights; near misses of Venus and Mars with payloads up to half a ton and communications relay satellites in earth orbits.

In the aeronautical field, which once dominated NACA research, NASA is continuing substantial programs in high speed transport aircraft and in VTOL and STOL techniques. The possibility of rocket powered transports is considered a dim prospect in the forseeable future, and NASA is proceeding with research on transonic, supersonic and hypersonic transports with the confidence that airline transports will continue to cruise in the atmosphere and use airbreathing engines.

Pershing Titanium Casing Order Canceled

By Michael Yaffee

New York—Army is canceling its order with Pratt & Whitney for 55 full-scale titanium casings for the Pershing missile and will revert to less costly steel casings for the program.

Use of heavier steel casings is expected to cut the range of Pershing by 50 mi. and probably will mean other weight compromises.

Decision caused dismay among titanium producers because the Pershing work was considered the most sophisticated and advanced titanium development program to date. The results of this work were expected to unlock the door to large-scale titanium application in the missile and space field.

Economic Considerations

From what can be learned, the Army's decision to go to steel on the Pershing was dictated primarily by economic considerations. At the present time, a full-scale titanium casing for the Pershing might cost 2½ times as much as a steel casing. In production, the cost might drop to 1½ to 2 times that of steel. This factor becomes even more significant when it is considered that titanium casings were being developed for both the first and second stage of the Pershing. Moreover, the Army is believed to be having difficulty trying to find funds for the missile.

There are a number of other titanium programs under way in the missile field today, but at the present time none of them is considered in the same class with the canceled Pratt & Whitney project as far as promise and technical attainment.

The Polaris fleet ballistic missile program, which is believed to have encountered difficulties in achieving the desired range, may yet provide the titanium industry with an opportunity to crack the missile field in a major way. There has been a titanium development program in progress for the past two years in casings for the Polaris, but, says a group of titanium engineers, it has failed to pay off owing to the contractor's lack of experience in handling titanium.

The contractor, for example, fabricated a casing with a longitudinal seam which, they say, cannot be done successfully with titanium.

For this reason, among others, companies with experience in the fabrication of titanium are seriously considering making a bid for titanium work on the Polaris.

Aerojet-General and Beech Aircraft reportedly are doing work for the Air Force on the development of titanium containers for the ground storage of liquid hydrogen. One unit is expected to be a sphere 30 ft. in diameter that may have to be constructed on site.

Some titanium will be used in the nozzles of the first production models of the Polaris missiles, due principally to the development work Aerojet-General has been doing with titanium.

Hercules Powder Co. has given Curtiss-Wright a contract to develop titanium casings for the third stage of the Minuteman ICBM. Hercules is interested in exploring these as an alternative to the plastic casings now considered for this job. Another company hopes to compete with titanium casings for the second stage of the Minuteman.

Since titanium is going into the Project Mercury capsule, and the metal also is expected to find an application in the Dyna-Soar capsule.

To Pratt & Whitney, which was doing the titanium casing work for Pershing under subcontract to Thiokol, the cancellation means a serious curtailment and, possibly, an end to its participation in the Pershing program. Present plans now call for Pratt & Whitney to make only three full-scale titanium casings for the Pershing second stage.

As planned, Pratt & Whitney will supply the so-called interim steel casings for the Pershing. Originally, Thiokol, which has the subcontract from Martin for the Pershing, Originally, Thiokol, asked Pratt & Whitney to make a number of steel casings which could be used in the Pershing program until the titanium casings could be developed and produced. The steel casings have been in order for eight months and the first shipment now is in transit to Thiokol. It has not yet been decided which company will get the production contract for the steel Pershing casings.

Although Pratt & Whitney refuses to commit itself on its future plans for titanium, there is a possibility that the company will try to put its titanium experience to use in the Polaris and, possibly, the Centaur programs.

There also is the possibility that titanium will find its way back into the Pershing program. Present plans call for Pratt & Whitney to fabricate three full-scale titanium casings for the Pershing. If test data on these finished casings prove that titanium will live up to the promises it now shows, according to one solid propellant engineer, then there is a chance that titanium casings will be returned to the Pershing and other missile programs now under way.

As far as the missile itself is concerned, the decision to abandon titanium means an increase in total weight of roughly 160 lb., a loss of 50 mi. or more in its maximum range of approximately 700 mi. and, assuming a cut in weight of the warhead, a loss in the overall effectiveness of the weapon.

Looking at it from a somewhat different angle, some engineers believe that it might even have been possible to extend the range of the Pershing to almost 1,000 mi. by using titanium and taking advantage of "other technological advancements."

On the other hand, the decision to go to steel casings is not expected to cause any delays in the Pershing program. It may, some engineers feel, mean a loss for all practical purposes of the $800,000 or so that the government has put into Pratt & Whitney's titanium casing development program.

On the technological side, titanium seemed to be more than justifying itself for missiles. The Army, Martin, and Thiokol reportedly were more than satisfied with the progress Pratt & Whitney has been making on the titanium casings for the Pershing.

New Alloy

In this particular program, which has been under way for the past year, Pratt & Whitney has been working with the company's new all-beta titanium alloy (AW Sept. 1, 1958, p. 37). From the results of this work and its earlier jet engine work with titanium, Pratt & Whitney is convinced it can fabricate full-scale solid-propellant casings from the all-beta titanium alloy with yield strengths of at least 180,000 psi.

For steel casings, the comparable yield strength figure now is 240,000 psi. But high yield strength is not the only characteristic desired in casings. At the start of this program, Pratt & Whitney was asked to develop a rocket casing material that would have a yield strength-to-density ratio of one million. When density is thus included, the all-beta titanium alloy with a density of 1.75 lb./cu. in. gives a ratio of roughly 1,029,000 while a high strength steel (one that would produce a yield strength of 240,000 psi.) with a density of 2.78 to 2.80 lb./cu. in. offers a ratio of roughly 860,000.

The equivalent of an all-beta titanium casing with a yield strength of 180,000 psi. then becomes a steel casing with a yield strength of 280,000 psi. The development of steel casings with this strength is entirely feasible. But the work at Pratt & Whitney shows that by rigorously controlling the processing of the all-beta titanium alloy, it is possible to obtain a casing with a yield strength of 200,000 psi. and to match this on a strength/density basis, a steel casing would have to have a yield strength of 320,000 psi.

Yield strengths of 320,000 psi. have yet to be obtained in production-line steel casings. On the other hand, Pratt & Whitney's 200,000 psi. figure for titanium has only been obtained so far with experimental rings. But the titanium advocates feel that the Pratt & Whitney data indicates it will be easier to obtain titanium casings with yield strengths of 200,000 psi. than steel casings with yield strength of 320,000 psi. Moreover, they say, considering the relative newness of the all-beta titanium alloy, it is very likely that it can be developed to produce casings with yield strengths substantially greater than 200,000 psi.

Translated into final results for a missile such as the Pershing, the use of titanium casings in place of steel casings to contain the same amount of propellant would save weight. This weight saving, which becomes more important in each succeeding stage, can be turned into added payload or range.

Another advantage of the all-beta titanium that becomes increasingly important in long-time storage is its superior corrosion and stress-corrosion resistance. The work at Pratt & Whitney has led project engineers to conclude that the all-beta titanium will outlo all materials considered for this job including the cold-worked and precipitation-hardened stainless steels.

Principal Process

Principal process used by Pratt & Whitney in the fabrication of titanium casings is flow turning. Carried out on flow-turning machines made by Pratt & Whitney by Ludge and Shipley, the process is similar to roll forming (AW May 18, p. 119) and consists of cold-forming metal over a mandrel by means of a spinning wheel. The starting structure is a roll-forged ring which is flowed out into a cylinder. Titanium end closures for the casing are domed forgings which are joined to the cylinder by girth welds. Igniter bosses are formed as an integral part of the case and closures. Three-dimensional machining, while expensive, is considered essential for the flow-forming finishing.

As expected, welding of the all-beta titanium alloy proved to be difficult. With a great deal of experience in welding titanium, gained from its jet engine work with the metal and from some preliminary work on the all-beta alloy, Pratt & Whitney decided to use annealed or unhardened welds on its titanium rocket casings. Metal sections next to the weld area are beefed up 25-50% with the weld bead running about 20% thicker than the adjoining parent metal in order to compensate for the soft welds.

Army Shows Sergeant at Aberdeen Proving Ground

Army Sergeant artillery missile is equipped with vanes which extend and retract from the solid-propellant weapon's body to correct trajectory. Sergeant, not formally operational, is in the first stages of production; parts of the weapon system are still in the final stages of development. Jet Propulsion Laboratory is developing the 36-ft. long missile for Army.

Northrop to Build GAM-87A Guidance

Washington—Guidance subsystem contract for Air Force's GAM-87A anti-ballistic missile system has been awarded to Northrop Corp.'s Nortronics Division by the prime contractor, Douglas Aircraft Co.

This is the final subsystem contract to be let for the two-stage solid propellant missile. Aerojet-General will supply propulsion and General Electric will provide re-entry body design. Air Force system management is based at Wright-Patterson AFB, Dayton, Ohio.

The guidance system does not include the missile autopilot and probably will not require installation of additional navigation and guidance gear in the standard USAF bombers scheduled to carry the GAM-87A. This indicates that finer launch position data and vertical reference needed for the ballistic guidance problem must be derived within the missile. Nortronics specializes in stellar inertial guidance systems which can meet these requirements.

In recent months the company has been seeking to diversify the applications of stellar inertial guidance equipment and techniques which have grown out of a program that began with the Mark 5 stellar inertial system used in the Northrop SM-62 Snark airbreathing missile system.

One trend in recent equipment has been to save weight and improve reliability by eliminating special analog-digital converters through design of star trackers and stable platforms with digital outputs. Most recent Nortronics stellar inertial system is the A-5 model intended for an airborne early warning and control aircraft that was never funded. GAM-87A will not need guidance as costly and complex as the A-5 which was to have been used for long duration flights. It probably will incorporate many of the A-5's features, however.

Out-of-Atmosphere Anti-Ballistic Missiles Studied by Chance Vought

Dallas—Anti-ballistic missiles with ranges out of the atmosphere and beyond are just one of the projects Chance Vought mentions in its "products package." Company President F. O. Detweiler revealed here last week.

In addition to mentioning Chance Vought's interest in this field for the first time, Detweiler revealed that the company will strengthen the basic and applied research programs supported by each of its five divisions by developing an entirely separate Chance Vought Research Center aimed at generating new knowledge.

Detweiler noted that the need for diversification required as a result of defense spending ceilings will carry Chance Vought into additional expansions outside the aircraft industry to supply commercial markets, although these plans are not yet ready for formal announcement. The company last year acquired its first subsidiary, Genesys Corp., Los Angeles, a computer systems firm.

High cost of today's defense systems—some of which are expected to cost up to $10 billion from concept through operational use—will ensure that there will not be too many such systems in the total procurement. He noted that cost of such a system would have provided for all the bombers, fighters and transports purchased just 10 years ago.

Program reductions resulting from purchase of today's costly weapon systems come at a time when the industry must invest larger amounts of its own money in research, test and production facilities. This reinvestment rate, he noted, is already greater than that of any other industry, accounting for approximately 60% of earnings. The aviation industry's net earnings last year after taxes averaged only 2% of sales.

As a further indication of the rising cost of weapons, Detweiler noted that during World War II cost of aircraft was approximately $10 per pound, during the Korean conflict this climbed to about $25; today's high performance aircraft are costing $50 or more per pound, and for the next generation of very high performance planes the cost per pound will probably be near $100.

Chance Vought expenditures for research and development in the first six months of this year represented an increase of more than 70% over the same period in 1958, Detweiler reported, and will result in expenditure of $8.5 million this year. The company's current backlog amounts to more than $300 million.

Although the company is well advanced in developing space flight and systems capabilities—its pilots and engineers have made more than 200 missions in the company's earth-orbital navigational flight simulator—Detweiler emphasized that manned aircraft still play a big role in the company's future.

The company believes that the F5U Crusader series carrier-based fighter will be responsible for providing it with more than $1 billion in contracts over the airplane's entire history. A $25 million contract last June for additional F8U-2N limited all-weather fighters is expected to be considerably increased by a larger follow-on order to be announced soon, he said.

ALBM Comes Close To Satellite Path

Washington—Martin air-launched ballistic missile test vehicle fired from a Boeing B-47 bomber near Cape Canaveral, Fla., last week came "fairly close" in its effort to cross the trajectory of the Explorer VI satellite as the vehicle neared its perigee (about 160 mi.) above the earth.

An Air Force spokesman said late last week that although the data obtained during the flight is still being evaluated, all indications pointed to a highly successful test after earlier attempts to conduct the experiment had failed (AW Oct. 5, p. 34).

Primary purpose of the experiment was to obtain data on the trajectory of an ALBM and to test the Martin developed guidance system as well as demonstrate the feasibility of firing ballistic missiles from aircraft.

The test vehicle, left over from the USAF ALBM competition, subsequently won by Douglas Aircraft Co., was fired from the B-47 by a three-man Martin crew, reaching its apogee at the relative perigee of the satellite.

The test vehicle was programed to fire five flares at intervals as an aid to ground-based cameras attempting to photograph it. One flare was observed at about 330 sec. after launch as the missile neared its apogee.

Air Force spokesman said the beacon on the second stage of the missile was tracked by the National Aeronautics and Space Administration's Wallops Island, Va., station from 80 sec. after launch until 600 sec. after launch.

The second stage fell into the ocean approximately 1,000 mi. off the coast of Nova Scotia. The Air Force declined to say just where the first stage fell. It followed a ballistic trajectory but did not attain sufficient speed to burn upon re-entry.

An earlier attempt to launch a Convair-developed ALBM test vehicle from a Convair B-58 toward the trajectory of the Discoverer V satellite failed because of telemetry problems. The Martin vehicle fired last week was scheduled to be fired earlier but was canceled two seconds before the scheduled firing because of technical difficulties.

Soviets' Third Lunar Probe to Orbit Earth

Moscow—Russia's third lunar vehicle, which "rounded" the moon last week, is expected to revolve around the earth Oct. 18 from north to south in an elongated ellipsis with an apogee of 292,043 mi., a perigee of 24,854 mi. and a period of 15.3 days.

Minimum velocity of about 0.24 mi. per second when it passed the apogee of its orbit increased to .31 mi. per sec. Oct. 12. It is to reach maximum velocity of 2.4 mi. per sec. when it comes closest to earth. The satellite is moving in a plane almost perpendicular to plane of the moon's orbit.

"Life expectancy of the space station is unlimited if one discounts such accidents as collisions with meteorites," one Soviet scientist said. The scientist, Dr. Ari Shternfeld, said the station will pass in the vicinity of the moon from time to time, coming closest in January, 1967, at 6,000 mi.

Explorer VII Satellite Launched by NASA

Washington—National Aeronautics and Space Administration's composite radiation satellite vehicle was placed into orbit last week in the last of a series of space experiments originally planned by the U.S. as a part of the International Geophysical Year.

The satellite, designated Explorer VII after its successful launch from the Air Force Missile Test Center, Cape Canaveral, Fla., is designed primarily to study the direct radiation from the sun and the fraction of this radiation which is converted into heat by the earth and ultimately reradiated back into space. Details of the seven experiments carried in the payload were reported by AVIATION WEEK last Aug. 3 (p. 61) after an earlier attempt to put the satellite into orbit failed when its Juno II carrier malfunctioned immediately after launch.

By late last week, all instruments aboard the Explorer VII appeared to be functioning, although signals from one of the two radio transmitters aboard

were slightly weak, it was reported

The transmitter, which operates at 108 mc and is powered by solar batteries, was designed to serve as a beacon for ground tracking stations as well as telemeter back measurements made by a micrometeorite experiment, and, despite their weakness, the signals were being received by all tracking stations

Signals from the primary 20 mc telemetry transmitter powered by two chemical batteries are strong and clear, NASA said Transmission from the solar transmitter will be cut off by an automatic timing device in the satellite at the end of one year

NASA set the period of orbit at 101.3 mm , the perigee at 316.6 stat mi , apogee at 701.9 stat mi Perigee velocity is 17,380 mph , apogee velocity 15 945 mph The 91 5 lb satellite was placed in orbit at an angle of 50 deg to the plane of the equator

The launching vehicle, designed by ABMA, was a conventional Juno II booster except for a support cylinder

Data being obtained from experiments and radioed back to ground stations will be processed in six weeks to two months and sent to experimenters for evaluation and analysis

British Establish Minister of Aviation

London—All aspects of British Aviation—both civil and military—will come under one ministry in the post-election reorganization of the British cabinet which does away with the old Ministry of Supply The reshuffle concentrates responsibility for promoting scientific development under one cabinet member, the Lord Privy Seal

New Minister of Aviation is Duncan Sandys, who yields his post as defense minister to Harold Watkinson, former Minister of Transport Civil Aviation

Sandys takes over civil aviation responsibilities formerly in the Transport Ministry, and all matters related to research, development and production of civil and military aircraft, guided and atomic weapons, radar and electronics, all of which were previously administered by the Ministry of Supply

No new science ministry has been formed to promote British scientific effort in the civilian field as was generally predicted before the election Instead, the duties of the Lord Privy Seal have been extended to embrace space research and all matters related to atomic energy in particular and the promotion of scientific and technological development in general

Lord Hailsham, who has been holding the office of Lord President of the Council (and chairmanship of the Conservative Party), has been appointed the new Lord Privy Seal

News Digest

Britain and the U.S. have agreed to exchange personnel to obtain better coordination between the two countries in their development of air navigation aids and aviation facilities Agreement was an outgrowth of a conference of high level British and U S aviation officials, which was concluded last week in Washington The United Kingdom delegation was brief on Federal Aviation Agency research and development program and visited National Aviation Facilities Experimental Center in Atlantic City, N J

Northrop and General Electric engineering team will begin testing in December of advanced thrust-augmentation system to be applied to J85 turbojets to provide speed in excess of Mach 2 in the first production-line N-156F fighter airplanes Pre-compressor cooling system for the N-156F uses water to cool air entering the engine as opposed to water injection used on jet transports

Bell Aircraft Corp has turned its X-14 VTOL aircraft over to NASA for further flight tests at Ames Research Center, Moffett Field Calif

Trans-Australia Airlines intends to order about $56 million worth of British jet airliners by 1961, according to Warren MacDonald, National Airlines Commission chairman currently in London Choice will be between Vickers VC 10 and de Havilland DH-121 as they appear to be the only suitable jet aircraft available for the 1963 66 delivery date MacDonald said

Nike Zeus Future

Washington—Experimental Nike Zeus anti-ICBM missile was fired last week from White Sands Missile Test Range as part of series of tests scheduled to extend through next Spring which may determine the future of the Army program Army termed the test successful, despite a malfunction during the coasting phase which caused it to fall short of trajectory

Complete technical appraisal of the Zeus program now is under way in Defense Department Current estimate is that $13.5 billion will be required to implement Nike Zeus missile installations to protect major urban centers and military installations The Fiscal 1961 budget is not expected to seek additional funds for Zeus program beyond the $135 million authorized in 1960 budget However, if President Eisenhower decides to fully implement the program, Defense Department will ask Congress to provide funds in a supplemental appropriation

BOAC Stand May Spark Price-Cut War

Carrier's determination to set its own standards will leave IATA members without basic structure.

By L. L. Doty

Tokyo—British Overseas Airways Corp., in an uncompromising drive to fix its own rate standards, has scuttled the International Air Transport Assn. traffic conference in Honolulu and set the stage for an open rate situation that could deteriorate into a price cut war on international airline routes next year.

The strong stand taken by the British carrier, reportedly with the determined backing of British manufacturers and the Minister of Transport, leaves some 80 IATA members without any basic fare structure on all international routes, including the transatlantic and transpacific, except those in the Middle East and Europe and between North and South America.

The Honolulu traffic conference (AW Oct. 12, p. 40) boggled down when it became evident that British delegates were unwilling to negotiate on of the give-and-take issues at stake. Last year, the traffic conference broke up in a deadlock at Cannes over the jet surcharge issue but a substitute method of the recommended conference in Paris in February saved the carriers from an open rate situation.

This year, however, a majority of the large airlines took a strong stand against any resumption of the talks when the British showed no signs of relenting on major points. And, at the general meeting of IATA here, the association's executive committee announced late last week that it would not authorize a reopening of the traffic conference. Rates now in effect expire on Mar. 31 and fares after Apr. 1 will definitely be open rate.

Controversial Points

There are three main controversial points which have caused the stalemate:

- **Seating configuration.** BOAC wants to include sleeperette-type seats on jet aircraft without extra charge. Other carriers want standard pitch for first class seats on jet aircraft but are willing to concede deep reclining or sleeperette seats without surcharge for operators of piston-engine aircraft on long haul routes. BOAC has locked horns with Air India International on the installation of berths which Air India wants but BOAC opposes.
- **Tourist class.** BOAC wants to retain three classes of service—first class, tourist and the economy plan. Most of the international carriers, viewing the rapid decline in the demand for tourist service over transatlantic routes, want to see tourist class service dropped.
- **Fare level.** BOAC wants to expand the economy fare throughout all international routes. Other carriers strongly support lower fares but insist that none of them cannot absorb lower fares without substantially increasing revenue ratios to produce deficits on low density routes. Most observers here feel that the British stand on these points is keyed to the load capacity and operating characteristics of aircraft manufactured and operated by the British. British European Airways ran into no major difficulty in reaching agreement with other carriers on the fare level for European routes.

Most carriers now feel that tourist class services have been made obsolete by economy plan type service. The British presumably want to see a continuance of tourist service on many international routes because of the large number of civil servants who will use tourist class in preference to the economy plan but who cannot afford first class type service.

On the fare issue, a majority of the airlines want to see an end to jet surcharges on fare differentials and allow piston-engine operators to provide additional services plus more commodious seating configurations than are offered by jets at no additional cost to passengers as a means of maintaining a competitive character between the two types of aircraft.

The deadlock over the three main issues poses a serious threat to the IATA traffic conference mechanism. Delegates here view the clash between the British and other members of IATA as a far more serious breakdown in inter-airline relations than last year's struggle at Cannes over the jet surcharge issue.

Showdown Sought

Like last week, most carriers were willing to take this risk as the only means of bringing on a showdown with BOAC. As the general meeting drew to a close last week, the British bloc consisting of BOAC and five Commonwealth carriers gave no indication of relenting in its determination to push the expansion of lower rates without changing configuration to match those rates on a world-wide basis.

During the closing hours of the traffic conference, when late night sessions were held in unions to reach some compromise that would remove the threat of an open rate crisis it became apparent that further negotiations with the British would be hopeless.

Specifically, BOAC stood firm throughout the conference for an economy plan rate on Europe-to-Africa routes and routes to the Far East that would be 20% below the standard tourist fares now in effect in these route regions. The carrier also wants to retain both first and tourist configurations for all aircraft operating over these routes.

South African Airways told the conference that it could not face the public criticism that would result in its area if it failed to return without authority to lower fares. East Africa and Central Africa airlines were equally firm.

It became increasingly evident to delegates during the course of the conference that BOAC and the Commonwealth carriers were acting under a virtual mandate from the British government to bring about a revised rate structure.

IATA to Copenhagen

Tokyo—International Air Transport Assn.'s general meeting will take place in Copenhagen next year, to be followed by Sydney, Australia in 1961 and Dublin the next year.

President of IATA this year is Seijiro Yamagita, head of Japan Air Lines, which was host company of the 15th annual general meeting here.

Nobusuke Kishi, prime minister of Japan, Shuji Masutani, deputy prime minister, Watara Nanahashi, minister of transportation and Ryutaro Azuma governor of Tokyo addressed the opening session of the general meeting. Prince Takamatsu was present at the meeting.

First CL-44 Rolls Out

First CL-44, a side loading airfreighter, is rolled out at Canadair, Ltd.'s Montreal plant. Twelve of the side-loading versions have been ordered by RCAF, Flying Tiger Line and Seaboard & Western have ordered swingtail models. First flight is slated for November.

W. G. Wood, of Trans-Canada Air Lines, conference chairman who was unanimously lauded for the manner in which he maintained control over the bitter conference in-fighting, named the delegates on several occasions that the conference was threatened with a "serious crisis." He admitted that much had been achieved in the early stages of the conference but added that it was a "terrible pity" that members airlines were faced with a deadlock in the closing hours that could "wreck" IATA.

Wood told delegates that the choice of a compromise lay with the members themselves and urged that a strong attempt be made to reach a solution of the differences existing between the two warring factions. BOAC delegates referred to the chairman's statements as very serious remarks and reiterated their determination to introduce their proposed rates on African and Far Eastern routes.

There was strong indication at the general meeting that the British were prepared to take multilateral action and introduce the fare plan on Apr. 1, regardless of the opposition of other IATA carriers.

Most carriers opposing the British position charged that the African market is extremely limited because of the low economic level prevailing in most African countries. One member said privately that lower rates would not attract any more travelers than those now using the airlines since "we are catering to a market that is still without sufficient food."

BOAC delegates admitted that there may be some areas which are not yet ripe for the economy plan rates it proposed but added that there are many territories—particularly East Africa, which are prosperous and provide attractive vacation sites. The British urged IATA to take no steps that would put a "fence" around these territories, thus causing them embarrassment.

In obvious response to British demands for lower rates on Far Eastern routes, J. R. D. Tata, chairman of Air India and retiring president of IATA, had this to say at the opening plenary session of the general meeting:

"During the same period (that transatlantic fares were being lowered), minimum IATA fares between London-Bombay and Bombay-Tokyo, which were always substantially lower than European and Atlantic fares, have remained about the same or edged slightly downwards."

He later told AVIATION WEEK that fares on these routes were now in line with other fares and that a 20% reduction would be disastrous to unsubsidized operators.

On this point, he told the IATA general meeting that "while there are no doubt within IATA some high cost airlines subsidized by their governments, others are recognized as being as lean and aggressively efficient as any transport operator in the world and even they have only managed to make pretty thin profits up to now."

During the traffic conference in Honolulu, KLM Royal Dutch Airlines, in one almost successful compromise move, suggested that all current fares be revalidated for another year on the grounds that the BOAC proposal may be too early. KLM delegates said they were offering the compromise move in an attempt to stave off another conference adjournment without agreement as happened at Cannes. The KLM move was seconded by Sabena.

Pan American agreed to the motion but added that all fare structures must continue to be related to seating capacity. Although a strong proponent of low fares, Pan American made no overt move to side with the BOAC stand, and later at the general meeting led the opposition with SAS to the BOAC proposals. Pan American made a strong bid for a promotional type fare, particularly in the North Atlantic region. Discussions on such fares, including a final decision on jet surcharges, were sidetracked by the deadlock on other issues.

Air France echoed the warnings of other carriers against adjourning in "defeat." The French delegates said the governments may step in to administer rates and tariffs through "civil servants who may not be conversant with airline business." They added that troubles "carriers now face will be nothing to those they might face if this eventually becomes a fact."

Most delegates viewed the BOAC proposal as a losing proposition at the outset. One group estimated that costs of operation on the Far East and African routes would call for a "124% load factor or standing room only" as a breakeven point.

The British bloc, however, was insistent that lower fares would develop new markets, thus creating higher load factors, and that seat costs would be substantially reduced by introduction of the 34-in.-pitch seats of the economy plan on a wide scale. Alternatives such as gradual introduction of promotional or developmental type fares were largely rebuffed by the British.

Chief reason the traffic conference was bogged down by the British position is that close interrelations of other fares on other routes to the fare structure on Far East and African routes prevents the individual handling of regional fare problems. This means that the expansion of economy rates in the Pacific area may be delayed officially beyond Apr. 1, the target date Pan American had set for the introduction of lower fares in that area unless the airline takes advantage of the open rate situation.

DOUGLAS DC-7F cargo conversion's passenger windows are permanently sealed by dural plugs. Cargo door replaces passenger door.

DC-7F Service Marks Cargo Race Start

By Glenn Garrison

New York—Introduction this month of the first Douglas DC-7 aircraft converted into all-cargo service marks the beginning of a new air freight push by several carriers, sparked by the availability of equipment as late-model piston planes are replaced by jets on the blue ribbon passenger runs.

American Airlines has received the first units of its airfreighter DC-7Bs in a total order of 10 which Douglas is converting from DC-7Bs at a cost of $4.25 million. Pan American World Airways expects to get the first of 10 DC-7 cargo conversions in December under a contract with Lockheed Air Service, Ontario, Calif. United Air Lines has ordered six of the Douglas conversions and plans to begin putting them in service next spring.

Transcontinental and international all-cargo service by Trans World Airlines is being greatly expanded with the allocation of six Lockheed Super H Constellations to cargo runs. These aircraft were shifted from Military Air Transport Service work, where they recently completed a one-year contract involving the transatlantic movement of 121,000 military personnel and dependents and 4,200 tons of cargo.

Two converted Lockheed 049 Constellations also have been added to TWA's all-cargo fleet. "Up to now, we have done a good job of cargo service on passenger airplanes, but our lift of all-cargo aircraft has been limited," TWA President Charles S. Thomas said recently. "These (additional airplanes) will increase our present cargo lift by more than four times on international service and by nearly eight times on domestic."

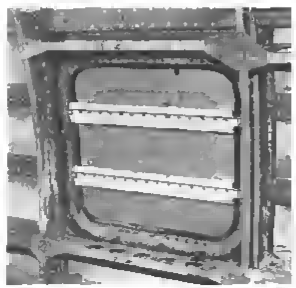
American chose the DC-7F to supplement its present 10 DC-6A all cargo aircraft as the plane best suited to fulfill "the immediate need of additional cargo lift" caused by the "rapid growth of the air cargo business." The DC-7F, according to American, was quickly available whereas "there was no advanced airfreighter on the market that would be available as quickly as the converted airplane."

Depreciation Factor

Besides availability, another obvious advantage of using the phased out piston planes is the fact that they are well along toward being written off in depreciation.

American's DC-7F's carry 33,500 lb. of payload vs. 30,000 for the DC-6A and 43,000 lb. for the Super H Constellation. The DC-6A cannot provide transcontinental service at maximum payload without a fuel stop whereas the DC-7F and Super H can.

The combination carriers presently face transcontinental all-cargo competition only from Flying Tiger Line, presently operating a fleet of Super Hs on its cross-country common carriage routes. Flying Tiger has placed a firm order for 10 Canadair CL-44D turboprop freighters and expects to get the first in the spring of 1961. On the basis of expected sharply reduced operating costs with these airplanes, Flying Tiger Line has announced plans to file a new tariff next year which will bring air freight rates down to a 13 to 14 cent per ton mile average. Current figure is about 18 cents. This new tariff, with rates ranging from a low of about 6 cents per ton mile, is expected to include specific commodity rates under an entirely revised structure.



WINDOW PLUG has two longitudinal stiffeners and is pressurized.

Flying Tiger's tariff proposal also will be based, according to President Robert W. Prescott, on an extensive research program instituted this year by the airline. First phase, scheduled to end this year, covers an analysis of the carrier's own records for the past 10 years, including breakdowns by commodity, route segment and seasonal fluctuations. Also in the first phase is a sampling survey of Flying Tiger shippers at various points, in which 3,000 shippers have been interviewed.

The new tariff, aimed at "maximizing profits," will be filed early next year and should become effective about 18 months later, or at the time the CL-44s become operative, Prescott said. During the interim he expects a long battle from other carriers which, with their "obsolete equipment," he expects to oppose drastic rate reductions.

Financing of Flying Tigers' $51 million CL-44 order has been completed, according to Prescott, with 80% of the purchase price guaranteed by the Canadian government. Another measure was issuance of $5 million of convertible debentures, of which $3 million went to General Dynamics Corp. and $2 million to private sources.

Flying Tiger projects its CL-44 direct operating cost at $.0457 per revenue ton mile for Fiscal 1962. This assumes 100% load factor at the aircraft maximum 66,000 lb. payload, 1,300 mi. route segment, average speed 350 mph., and average daily utilization of 11 hr.

By way of comparison, those units of the airline's Super Constellation fleet which were in common carriage of freight, as opposed to military contract work, operated at a direct cost of $.1023 per revenue ton mile for the 11 months ending May 31, 1959.

In the fiscal year ending June, 1960, the airline predicts it will carry 80.4 million revenue ton miles of air freight, using six Super Hs and one C-46. The Constellations will attain a load factor of 76% and will be utilized 9.1 hr. daily at a wheel-to-wheel average speed of 258 mph., according to the forecast. In the fiscal year ending June 30, 1961, seven Constellations and one C-46 will carry 93.2 million ton miles in the following fiscal period; three Constellations and four CL-44s will carry 159.7 ton miles and during the final fiscal year covered, ending in June, 1964, an all-turboprop scheduled fleet of eight CL-44s will carry 271.7 million revenue ton miles of air freight at a load factor of 71%, according to the forecast.

As to the disposition of the Super H fleet after the turboprops have taken over, Prescott pointed out that the aircraft will be written down and any losses would not be "insurmountable" even if "we have to tie them to a fence post."

By mid-1961, he said, the Super Hs will be written to about $½ million of their original $2.5 million cost.

Flying Tiger's operating costs for the projected air freight operations assume that the ratio of indirect to direct costs will remain at 55%. The CL-44's swing tail, along with prepalletized mechanical loading, will permit loading or unloading in 25 or 30 min., according to Prescott. This compares with four to five hours on the Super Hs, he said. Another expected saving, through greater utilization, is in the Rolls Royce Dart turboprop engines which will power the CL-44. Prescott said his airline's present rate of en route engine failures is one in 1,200 engine hours, whereas Dart engines on Vickers Viscounts now have a failure rate of one in 100,000 engine hours.

The ratio of indirect to direct costs of future cargo operation assumed by Flying Tiger is challenged by one of its big combination competitors, American Airlines. David Highman, American's director of air freight sales, believes direct operating costs may go down to 30-40% of indirect costs as aircraft become more economical and ground handling systems more complex and expensive.

"But you don't really know at this point," Highman adds, although in his view there is bound to be a difference from today's ratio. With the DC-7F, direct costs may be 45-55%, Highman estimates.

Proposals Analyzed

Regarding Flying Tigers' estimates of CL-44 costs, Highman said American has analyzed all cargo aircraft proposals and the airline can't "in our wildest imagination" see how the costs could be as low as Prescott predicts. Regarding Flying Tiger's plans to file the new tariff, the American official said there would be no objection from his airline to a proposal to end the minimum rate order, which he said a 6 cent rate would in effect do.

Highman doesn't believe an immediate price reduction is necessary to expand air freight and derides "the magic plane which will give a magic price tool" as the panacea for all air freight development problems. He more strongly stresses the "sales engineering" approach to cargo development, which involves selling air transportation as part of an industry's entire distribution system rather than only a quick means of moving goods.

Prescott espouses this philosophy too.

LARGE aft cargo door (above) swings upward; smaller side opening door is for personnel entry. Crash net at cockpit bulkhead (below) is made of plastic sheathed steel cable.

but has said that the price factor is far more important.

American admits that it will need something more than a converted piston airplane to compete against the CL-44. But it wants a turbine-powered cargo plane with a mechanized loading system designed as an integral part of the aircraft and doesn't want to design and apply such a system after buying the plane. Highman said American might have bought the CL-44 if such a unit had been included.

American is looking for a jet or turboprop freighter with direct flight costs of 4 cents per available ton mile. Turbofan possibility has been particularly attractive to the airline. It is projecting future operations on the use of two new turbine airplanes, one with a 45-ton payload and the other with a 25-ton payload. These assumptions were made in exhibits in a current air cargo case before the Civil Aeronautics Board in which a fleet of five DC-7Fs and 10 DC-6As is projected for the end of 1959. At the beginning of 1961, the fleet would include 10 DC-7Fs and 10 DC-6As, by 1965, five 45-ton turbine aircraft and 10 turbines with 25-ton payload would comprise the all-cargo fleet. The turbine aircraft are assumed to operate at the 4 cents per available ton mile direct cost and to permit establishment of a 15 cents ton mile rate in 1963.

The projections, American advised CAB, are based on the airline's obtaining authority to operate its all-cargo aircraft "with complete flexibility as far as route restrictions are concerned."

In computing its projections, American used a seven-year service life and 15% residual value in depreciating its DC-6As, and a five-year, 15% residual basis for DC-7F depreciation.

Direct flight costs of the DC-6As were projected at $7,213,000 for 1960, $7,589,000 for 1961, $6,900,000 for 1962, and $5,760,000 for 1963.

For the DC-7F, costs were $5,984,000 for 1960, $8,671,000 for 1961, $10,632,000 for 1962, $9,349,000 for 1963, and $7,191,000 for 1964. For the jet freighters, costs were $4 million for 1963 and $12 million for 1964.

Average daily utilization in 1964 was projected at 5.50 hr. for the DC-7F, 7.05 for Jet A, and 7.12 for Jet B.

As far as traffic is concerned, American predicts it will fly 259,850,000 revenue ton miles of freight, express and mail in its all-cargo aircraft in 1964. Forecast load factor is 70%.

Douglas sees development of a market able to support jet cargo carriers and solution of the problem of what to do with retired first-line passenger aircraft as potential benefits of cargo conversions of the DC-7 series.

Main part of the DC-7 conversion, which costs $485,950, is installation of a strong cargo floor nearly identical to that in Douglas DC-6A, Air Force C-118 and Navy R6D. If the customer is already operating the DC-6A, Douglas will make his DC-7 conversion as similar to his DC-6A as possible to hold down the cost of engineering and facilitate maintenance.

The DC-7 cargo floor is 40 in. longer than that of the DC-6A but structural design and load limits are the same and DC-6A cargo doors are used.

It takes about five months to convert a DC-7 to cargo. The passenger interiors are removed and the passenger floor, stressed for 29 lb. per running inch, is replaced by a cargo floor stressed for loads of 84 lb. per running inch. Both floors strengthen the fuselage shell about equally, taking some loads in tension. Heavier structure can be inserted in some places to make possible later conversion to turboprop power.

Doors and door frames are identical to those used in the DC-6A. The door limits the pressurization differential to 4.16 psi. or 75% of the 5.45 pressurization differential in the passenger version. Extra structural strength for pressurization to passenger requirements is retained as a bonus in the cargo version. In some places structure was made heavy for sound damping purposes and this, too, will be kept as additional strength in the cargo airplane.

Floor is light and strong, made of .032 dural sheet and corrugated stiffeners. Dural does not have a tough enough surface to survive the punishment of cargo operations. For this reason, it is protected by an easily replaceable plywood pad. Some cargo plane manufacturers believe a cargo floor should be constructed of strong, tough-surfaced magnesium plank which can be used without a protective surface. Douglas engineers argue that any cargo floor will probably have to be replaced eventually and that the difficulty of replacing a permanent floor is too great to be acceptable. Hard steel tie-down cups in the Douglas floor can take tool and pry bar loads without being gouged.

Tie-down rings are spaced on a 20-in. grid pattern. Each will withstand a 2,400-lb. crash load. Two steel cable crash nets are provided. One at the cockpit aft bulkhead will withstand 31,000 lb. at 6g and the other which can be installed at a row of rings around the fuselage at mid-cabin which will accept a 10,000-lb. load. Cargo floor rests upon a substructure of four longitudinal C-section beams with 6-in. webs. Floor is stressed for distributed load of 200 psf. Transversal bulkheads are installed under the floor at 80- to 100-in. intervals. A sheet of dural is laid under the two center beams to make the enclosed space serve as the main air distribution duct for the cabin.

American Denies Influence Charge

Washington—American Airlines has formally denied competitors' charges that it attempted to influence a Civil Aeronautics Board decision granting the carrier nonstop operating rights between New York and San Francisco and has asked the Board to reject a rehearing request filed by Trans World, United and Northwest Airlines (AW Sept. 28, p. 48).

Replying to charges that the airline sought to "pressure" Board members by means of letters from senators and congressmen, and state and municipal officials, American said 80% of the communications questioned were filed with CAB prior to a hearing in the route case and that all were available for public inspection in the Board's docket section. Airline attorneys said that none of the letters were written by American and that of the 66 filed after the start of the nonstop case, half were addressed to the Board the remainder communications from the CAB and that "virtually all" were written by congressmen.

Many of the communications the attorneys said, dealt solely with ordinary procedural matters, such as the setting of procedural dates and site of the hearings, while others were routine transmittals from congressmen asking for CAB aid in answering letters.

The few congressional letters which did express personal opinions on future outcome of the case, the carrier said, were a matter of public record and covered by CAB's own rules.

American also contended that attorneys for Trans World and United raised no objections during oral argument to the Board's announcement that the letters would be included in the public record, nor, they said, did the lawyers seek to inspect the documents.

Further objections raised by the two airlines that former CAB member Louis J. Hector had no right to vote on the disposition of the case because he was absent during the argument also was contested by American. The airline said that past court decisions have held that CAB may vote with a quorum of three members who may have heard arguments either by being present or by a reading of records and transcripts.

American said that neither United nor Trans World counsel had objected to Hector's participation in the case although both had been aware of his absence at the oral argument.

CAB Studies Ways to Expand Mail Plan

By Ford Eastman

Washington—Major expansion of the now limited Post Office program to move first-class mail by air may get under way within the near future.

Civil Aeronautics Board—required by law to establish a rate through proceedures that are normally long and drawn out, involving public hearings and arguments—probably will adopt a short cut that could permit the Post Office to begin moving additional mail by air immediately.

Rather than first scheduling the case for hearings, the Board can propose what it believes to be a "fair and equitable" rate after informal meetings with Post Office and airline officials and, at the same time, issue a show cause order. If exceptions to the rate are filed by either the Post Office or airlines, a temporary rate would be established under which the mail could be moved while the CAB proceeded with hearings. A permanent rate would be fixed at the conclusion.

Meetings Being Held

Meetings between the CAB and Post Office Department are now being held to establish procedures under which the expanded movement of first class mail by air can begin.

At present, the airlines are participating in an experimental program begun in 1953 in which regular first-class mail is transported by air between a limited number of points. Since the mail was to be carried on a space available basis, the rates set averaged between 18 and 19 cents a ton mile for trunklines as compared with a domestic average of about 40 cents a ton mile for airmail. For local service lines, the rates averaged 30 cents a ton mile as compared with an average yield of about 99 cents a ton mile for airmail. About 25,000 tons of first-class mail are moved annually under the program.

CAB estimates that in Fiscal 1959 a total of 18,096,000 ton miles of non-priority first-class mail were carried by air at an estimated dollar payment to the carriers of $3,296,000, including $107,000 for local carriers.

If the volume was increased from 25,000 tons to 175,000 tons as planned in the future, the dollar volume to the airlines would increase to $23,072,000, including $749,000 to local service carriers, assuming that the rates were about the same as those set for the experimental plan.

Under the Post Office Department's proposed program, air transportation would be used in these operations:

- **Between major population centers** where, although distances may not be great, surface transportation is such that overnight delivery is not practicable. This would include service between Chicago and Minneapolis, Atlanta and Tampa, Pittsburgh and Detroit, St. Louis and Kansas City, Washington and Boston, Cincinnati and Nashville.
- **Between overseas points** such as Alaska, Hawaii and the Commonwealth of Puerto Rico where water transportation is too slow for the standard of service required to maintain a proper community of interest. An estimated 560 tons of first-class mail would be moved annually to these points.
- **Between points served by local-service carriers** where surface transportation and other factors are such that the postal service would be improved. Initial estimates show that about 23,000 tons of first class mail would be involved each year.
- **Between points where service** would not only be improved but where a more efficient and economical operation for first-class mail can be obtained. This would involve an extension of the existing airlift from New York, Washington and Chicago to such points as Denver and Dallas and to the West Coast cities of Los Angeles, San Francisco and Seattle in both east and west movements. The extension would involve an estimated 29,200 tons of mail annually, some of which now moves by highway as well as by rail.

Greater use of airlines to move the mail is needed, Post Office spokesmen say, since in recent years "thousands of mail carrying passenger trains have been discontinued and service to thousands of communities has been eliminated entirely." The Department adds that there is no indication that the trend will be reversed. An added factor is that, while the rail volume declines, the volume of mail is expanding at a rapid rate.

In recent hearings before the Senate Committee on Post Office and Civil Service, Post Office Department witnesses testified that, in addition to the 25,000 tons of mail now airlifted under the experimental plan, there are another 150,000 tons of first-class mail in terms of 1958 volume moving over distances of more than 300 mi. by surface transportation. This if the new program is adopted, would eventually be moved by air.

Initially, however, only a portion of the 150,000 tons would be moved by air—about 53,000 tons within six to eight months after the program began. Third and fourth class mail representing the bulk of all mail, would continue to move by surface transportation in the immediate future, the witnesses said. Total mail moving more than 300 mi. amounts to about 2,614,538 tons.

The stage was set for an expansion of the program when the Post Office Department asked the last session of Congress to clarify the authority of the Postmaster General in making greater use of air transportation to provide for the "more expeditious, efficient and economical movement of mail."

At the same time, the Department asked for authority to contract for the air transportation of mail where necessary at rates different from those set by the CAB.

This met with strong opposition from the Air Transport Assn.

Immediate steps to expand the program were taken by both CAB and the Post Office Department when the Senate Post Office Committee reported that the Postmaster General already has authority to transport all classes of mail by air at rates fixed by the CAB.

Top-level meetings between the two agencies were held to work out details, and Post Office Department estimates of the amount of mail involved and the designation of points to be served were furnished the Board as a basis for determining the rates.

While the CAB can quickly clear the way for expansion of the program by issuing a show cause order, the establishment of a rate for the service may present a problem.

Airlines have not been satisfied with the rates set for first-class mail under the current experiment, although they agreed to cooperate since it was an experiment and since the mail moves on a space available basis. The rate requested by the Post Office Department was designed to be comparable to the cost of surface transportation.

What Airlines Want

Under an expanded program, the airlines probably will want a higher rate, one that is somewhere between the rate paid now for first class mail and the rate set for regular airmail.

The Post Office Department has indicated that since it must operate within its appropriations, it must move the mail by air at rates that will not cause a significant increase in costs over those for surface transportation.

Postmaster General Arthur E. Summerfield and other Post Office witnesses told the committee that, despite the increased use of airlines for moving first-class mail, there will be no significant diversion of mail revenue from the railroads. For the fiscal year ending June 30, 1960, he said, the railroads will be paid an estimated $351,234,000 for

Northeast Jet Order

New York—Northeast Airlines is expected shortly to announce an order for jet transports, probably the Convair 880. According to President James Austin, the airline may have jets of its own in service by next June. Austin told Aviation Week the order probably will be for seven to 10 airplanes.

The carrier plans to begin jet service on its Miami run in December with Boeing 707-320s leased from Trans World Airlines. Present thinking is that the use of the big leased jets will continue after the smaller jets are in service, with the latter going on other Northeast routes.

mail transportation. $58 million more than that paid in 1956. This, he said, is because of the increased volume of mail plus higher rates.

Summerfield said the proposed program was neither designed to cripple the railroad nor aid the airlines. Its purpose, he said, is to enable the Post Office Department to maintain its standard of service and relieve a critical situation caused by the curtailment of surface transportation.

Joseph P. Adams, executive director of the Assn. of Local Transport Airlines, said his organization strongly supported the proposal to increase the amount of first-class mail to be moved by air and urged that local airlines be utilized to a greater extent in the program.

Adams said the local airlines would not actually profit from greater utilization since the amounts expended for this purpose would reduce subsidy payments by a similar amount. Since subsidy payments are required in local carriers whether transportation of first-class mail is involved or not, this, in effect, would provide improved postal service to smaller communities at a lower overall cost to the government, Adams contended.

Action on contract authority for the Postmaster General—the most controversial issue connected with the airlift of mail—has been delayed.

In its report, the Senate committee concluded that the Postmaster General does not have authority to contract for air transportation to meet special needs at rates other than those fixed by the CAB. As a result, the committee recommended passage of a bill that would give the Postmaster General such authority and contain what the committee termed "reasonable safeguards to insure that such contracts do not produce undesirable conditions in the commercial aviation industry."

Since the bill was introduced late in the session, no final action was taken.

During the Senate hearings, the Air Transport Assn. maintained that such contract authority is not necessary and that it might have a chaotic effect within the industry. ATA testified that every time in the past that a U.S. government agency has been permitted to contract on a competitive basis for air transportation on any substantial scale, the rate levels have been driven down.

ATA President Stuart Tipton cited conditions that existed before passage of the Civil Aeronautics Act of 1938 when mail rates were bid downward, and finally, in a few cases, cases of zero bids were received and accepted.

Tipton said that "procurement practices of the Defense Department have driven the rates so low that the traffic has not made any contribution to airlift development and both the Defense Department and CAB are concerned."

"Tremendous flexibility," ATA said, "can be built into the rate structure fixed by the Board by following the air freight rate structure which provides for reduced rates for high volume and for long hauls, and which provides directional rates in the event of special movements of traffic."

Post Office Department witnesses said contract authority would be used sparingly and that the department would agree to safeguards designed to prevent contract rates from becoming unduly low. They added, however, that they have such contract authority in respect to surface transportation and that, if the department is to move mail expeditiously and without waste of taxpayers' money, at least a normal amount of discretion in the procurement of air transportation is essential.

German Transports Await Funding

Geneva—West German government is expected to make an early decision on prototype funding for two new transports being designed by the German aircraft industry (AW May 25, p. 49).

The proposed aircraft are the 70-passenger turbojet aircraft designed by Hamburger Flugzeugbau GmbH of Hamburg and a 23-seat twin turboprop plane designed by Ernst Heinkel Flugzeugbau of Speyer-am Rhein.

Initial request for both projects is about $15 million, which would only begin to cover development costs. Further funding by both industry and government would be necessary to support both projects through the initial flight test stage.

Larger of the two transports is HFB 314, a Caravelle-sized twin-jet design being developed by the engineering team at Hamburger Flugzeugbau. Gross weight of the current 70 passenger configuration is about 80,000 lb. Powerplants will be either two General Electric CJ805-23s or Rolls-Royce RB.141 turbojets. Design cruise speed is Mach 0.9.

Engines will be installed in the fuselage rear as in the style of the Caravelle but may be partially submerged. Final layout of the powerplant has is not complete, and is being studied by both engine manufacturers and HFB.

Initial plans of the company were to complete the first prototype for flight in late 1961, but the current realistic estimate is one year later, with production deliveries scheduled for late 1963.

First target market for HFB 314 is probably the Caravelle fleet of Air Union—European airline combine of Air France, Lufthansa, Alitalia and Sabena.

Heinkel's transport is a smaller turboprop plane planned as a replacement for the Douglas DC-3. Company sources declined comment on any characteristics of the plane.

French observers are frankly worried about these designs which compete directly with Sud Aviation's Caravelle and Super Caravelle and with Max Holste's Super Broussard.

They feel something has happened to Franco-German cooperation in the field of aviation.

Government sources in Bonn say nothing is yet firm on the projects, and that funds must be voted by the German Parliament before serious work can begin. Reports elsewhere said West German Lufthansa recommended these two designs but a spokesman for the airline denied that. He told Aviation Week that Lufthansa was in no position to check the design of airplanes but would naturally be willing to test the finished product of any country's aircraft industry. And specifically, he added, Lufthansa had no part in design, development or recommendation of these projects.

Allegheny Ticket Plan Gets Interim Approval

Washington—Civil Aeronautics Board has voted to investigate Allegheny Airlines' proposed discount "book ticket" and "no reservation" fares (AW Oct. 5, p. 41) but has authorized the carrier to go ahead with the plan pending completion of the investigation.

CAB ordered the investigation after Trans World Airlines filed charges that the plan is discriminatory but said there was insufficient evidence to block the proposal at this time. The Board also directed Allegheny to submit detailed figures on the actual operation of the fare plan while the investigation is being conducted.

Capital Reports Convair Jet Plan

Washington—Capital Airlines last week formally announced plans to purchase seven Convair 880 M turbojet and five Lockheed Electra turboprop transports for 1960 delivery as predicted by AVIATION WEEK (AW Oct 12, p 41)

Manufacturers' dates call for Electra deliveries in May, June and July, with first scheduled service set for June Convair 880 delivery dates have been set for October, November and December, with service scheduled to begin in December

Pilot training for the new aircraft probably will get under way by March for the Electra and July for the Convair Capital spokesmen say they are interested in obtaining a simulator for Convair 880 transition training, but that, since the number of aircraft involved does not warrant the expense of purchasing a simulator, the company probably will lease the equipment

The agreement of Vickers-Armstrongs, Ltd, manufacturer of the Viscount turboprop, to lift many restrictions, in effect refinancing the mortgage balance of about $37 million now outstanding on Capital's present Viscount fleet, has paved the way for the Convair and Electra purchase, the company said

Speculation that Capital might purchase the Boeing 707-720 instead of the Convair 880 was mentioned

Capital President David H Baker, in referring to earlier speculation that the carrier might shift from the 880 to the Boeing 707 720, said that "in the past three weeks' General Dynamics Corp, parent firm of Convair, made "substantial" changes in its offer to the company, which will allow the 880 to meet many of the advantages offered by the Boeing aircraft Baker also said financial concessions have been made by General Dynamics that will permit Capital to add a seventh Convair 880 without an additional short term cash outlay

Tailored to Capital specifications, the new jets are designated Convair 880 M and will be modified to permit heavier takeoff and landing weights and greater short field capability Maximum gross takeoff weight of the aircraft has been increased from 184 500 to 191 000 lb landing weight from 132 500 to 135 000 lb and fuel weight from 117 000 to 120,500 lb

Wing leading edge slats and a larger vertical fin with a power boost rudder will improve the 880 M short field performance, while an improved version of the General Electric CJ 805 3B turbojet engine equipped with thrust reversers and noise suppressors is expected to provide 4% more thrust on 2% less fuel Other modifications will incorporate such features as preloading baggage bins and track seats

Financial details of the purchase have not been disclosed by Capital but financial circles say credit is being negotiated with the Chase Manhattan National Bank of New York, through which Capital originally planned to finance a Convair 880 purchase two years ago Loan agreement is understood to cover the purchase cost of both the 880s and Electras plus spare parts but not Capital's Viscount mortgage balance of $37 million

Economy Fares

Washington—National and Northeast airlines last week served notice with Civil Aeronautics Board's tariff section that they plan to drop their special $45 economy class fares between New York and Miami (AW July 27, p 31) by Nov 7 or 8

Eastern Air Lines which also instituted the reduced fare shortly after National began the service in July, gave no indication as to whether it would follow the same course Both Northeast and Eastern originally objected to the National plan but told the CAB they would apply the same fare as a competitive measure

National spokesmen said the service is being dropped because the coach configurations of Lockheed Constellations used on the route are being refitted to handle an expected increase in first class passengers during the winter season

Hostess Union Sets TWA Strike Date

Washington—Air Line Stewards and Stewardesses Assn has set a Nov 8 strike deadline against Trans World Airlines to support its demands for a 70-hr monthly flight limitation for airline hostesses

The union contends that the limitation is necessary because of purported physical and psychological after-effects of jet transport flying which it says have been borne out by documented reports it has filed with the FAA

Basis for the complaint and the reports to FAA, the union says, is a series of almost 150 individual complaints that have been filed by hostesses within the last three months The complaints represent approximately half the stewardesses on jet duty on Trans World, American and Continental airlines according to a union spokesman

The ailments listed include ruptured blood vessels swollen limbs excess fatigue and changes in menstrual cycles

In each case recruiting by the union, the complaining hostesses reported that they began experiencing the ailments approximately 10 weeks after beginning work on the jets Company physicians who examined the hostesses believe the reported infirmities are of psychosomatic nature induced by a new environment although none of the complaints have been grounded on the basis of examinations by private doctors the union said

FAA medical authorities are inclined to agree with the carriers and say similar complaints were lodged when propjet aircraft first entered commercial service They told the union, however, that agency inspectors will conduct in-flight tests of interior cabin vibration to determine if ultrasonic sound waves could have a bearing on the problem

BEA Plans Interim Helicopter Service

London—British European Airways is planning interim helicopter service leading to full-scale operation with the Fairey Rotodyne VTOL, according to BEA Chairman Lord Douglas of Kirtleside Interim service would not begin for at least a year

We shall probably require a couple of 20 to 25-passenger multi-engined helicopters in the class of the American Vertol V-107 and Sikorsky S 61 or British Bristol 192C," Lord Douglas said

Helicopter Experiment Established by FAA

Washington — Federal Aviation Agency last week formally announced the establishment of an experimental helicopter traffic service designed to attack the problems of all-weather helicopter operations (AW Oct 12 p 52)

Daily flight patterns will begin about Dec 1 from Philadelphia to New York and from Bridgeport-Cuma, to the FAA National Aviation Facilities Experimental Test Center at Atlantic City, N J

Air traffic control of the agency's fleet of Sikorsky H 37s and HR2Ss will be provided by FAA's control center in New York City Each helicopter will operate about 300 mi a day, round trip Later a Vertol 107 twin turbine helicopter will be provided on a cost-sharing basis between the military and the manufacturer

Experiment may run a year or longer, FAA spokesmen say and will be primarily concerned with the problems of helicopter air traffic control in high traffic density areas qualifications of helicopter crewmen, aircraft problems navigation services needed and data on helicopter instrument flying

SHORTLINES

► **Air France** has divided its North, Central American and Caribbean Division into seven separate regions, with each reporting directly to the airlines New York office The regions and their headquarters are Northeastern at Philadelphia, Midwestern at Chicago Western on the West Coast, Southeastern at Washington, D C, Southwestern at Houston Caribbean at Miami, New York in New York City The French airline recently opened an office in Newark, N J, and plans to open others in Cincinnati, Indianapolis, Minneapolis, Portland, Ore, and Kansas City

► **American Airlines** flew some 768,000 passengers a total of 532 million revenue passenger miles during September, a 12 and 25% increase respectively over September of last year The airline reports that during the third quarter of 1959 it carried approximately 2,256,000 passengers over more than 1,691,106,000 revenue passenger miles, up 10 and 21% respectively over the same quarter of 1958

► **Guest Airways of Mexico** has taken delivery of three Lockheed Super G Constellations formerly operated by Thai Airways and will place the aircraft on its Mexico-Europe and Mexico City Caracas routes The Super Gs were refurbished by Flying Tiger Line at the carrier's overhaul and maintenance base in Los Angeles Guest expects the Constellations to cut five hours from the airline's former Douglas DC 6 schedules

► **Hawaiian Airlines** has begun operation of a twice weekly scheduled service from Honolulu to Midway Island under the terms of a recently signed contract with Air Force's Military Air Transport Service Flights will leave Honolulu International Airport at 10 a m on Monday and Wednesday mornings, returning before midnight the same day Under terms of the contract with MATS, Hawaiian will transport 72 tons of cargo and passengers each month on the flights through September, 1960 The carrier was awarded the contract on a low bid of $518 391 36 for 108 round trips Douglas DC-6 aircraft will be used

► **National Airlines** will operate four daily Boeing 707 turbojet round-trip flights between New York and Miami beginning Nov 1, using a combined first-class and aircoach configuration

► **Seaboard & Western Airlines** has increased its U S Europe mail and cargo service to 13 round trips per week

AIRLINE OBSERVER

(The following column was compiled by Aviation Week staff members covering the 15th annual general meeting of the International Air Transport Assn in Tokyo)

► Watch for the trend toward regional pools operating jet transport equipment to spread from Europe—where the European Air Union (Europair) already is established—to Asia and Africa. Exploratory efforts ahead have been undertaken by Ethiopian Airlines, Ghana Airways, Egyptian Misrair and Liberian Airlines plus local companies in Nigeria and Sudan, to form a TransAfrican Airways for pooling jet equipment, maintenance and operations The French are cooperating in the TransAfrica effort offering the technical assistance of UAT, the French airline which operates primarily to Africa Formation of an Asian bloc is more complex, with three possible patterns developing Both Japan Air Lines and Air India are jockeying for domination of a possible pool oriented toward their geographical areas, while a third force emerging is spearheaded by Air Vietnam, which is seeking to form a bloc of airlines such as Royal Air Cambodge of Cambodia, Malavan Airways, Garuda Indonesian Airways and the Union of Burma Airways, with Philippine Air Lines as the leader, providing technical assistance through U S channels Meanwhile, the British Commonwealth bloc is moving fast toward organizing by January, but prospects, including Air India's relation to this bloc, are dim

► **Communist penetration of Southeast Asia via the commercial airlines is growing, with an application by Garuda Indonesian Airways and Air Burma to Communist China for technical assistance in improving their faltering airline operations, seriously jeopardized by the lack of technically trained personnel and modern communications and navigation facilities**

► Thai Airways' acquisition by Scandinavian Airlines System also is causing a sharp look at the possibility of large airlines acquiring new traffic rights through assumption of the bilateral rights of small airlines SAS long denied traffic rights to India, may now acquire them by operating Thai Airways routes U S airlines are particularly resentful of this trend since the Civil Aeronautics Board denies them an equal opportunity to gobble up these plums available to major European carriers

► Sud Aviation is planning to retrofit its twin-jet Caravelle transport with General Electric aft fan turbojets Both Air France and SAS are interested in this program which will enable the Caravelle to fly 2,000 mi stage lengths and offer better block speeds, primarily from a faster rate of climb SAS now is operating 16 Caravelles with its services to Cairo and Khartoum the longest routes to date

► Pratt & Whitney Aircraft is raising ratings on the J75 commercial engine (JT4) to 17 500 lb dry thrust by next July Current rating of the J57 (JT3) with water injection is 13,500 lb thrust

► **BOAC reports that the de Havilland Comet 4 missed by only a single day a full year's operation over the North Atlantic route without a serious mechanical delay. An emergency engine change broke the string of 364 days**

► Aviaco, Spanish domestic airline, has purchased five Convair 440s from Sabena to expand its local service and operate an equipment pool with Iberia Aviaco President Jose Paso Montes also is interested in establishing helicopter service in the Canary Islands A survey of these routes already has been made with a Spanish military Sikorsky S-55 Montes wants twin-turbine helicopter equipment for these routes

► **U S Air Force will continue to fund development of the Allison T61 turboprop engine (AW Oct. 12, p 34) through Fiscal 1960, with Allison adding considerable private financing to keep the project alive in anticipation of an eventual resolution of the congressional cargo plane controversy**

► British independent airlines, which are offering rates below current standard fares on such colonial routes as London-Hong Kong, are prompting European flag carriers to expand charter service as the only means of competing

The Breakthrough Air Freighter that *smashed* the cost barrier!

CANADAIR JET-PROP CL-44

...the first aircraft designed specifically for the air cargo industry

The jet-prop CL-44 was designed specifically to meet the immediate requirement for an aircraft that would significantly lower the cost of cargo movement.

In this highly important role, the Canadair CL-44 breaks through the transportation cost barrier and will revolutionize the whole air cargo market. It provides direct operating costs of less than 4¢ a ton mile and breakeven load factors as low as 28%, which are both lower than those of any other aircraft anywhere in the world.

The swing-tail CL-44 is already in production for the largest air cargo carriers in the world—Seaboard & Western Airlines Inc. and The Flying Tiger Line Inc.

- Payload—64,000 lbs • Range—3,000 mi. • Speed—400 mph
- Engines—4 Rolls-Royce Tyne 12 • Cubic capacity—7,391 cu. ft.
- Floor loading—300 lbs. per sq. ft. • Passengers—up to 183
- Span—142 ft. • Length—138 ft. • Cabin length—98 ft.
- Gross weight—205,000 lbs. • F.A.A. takeoff field length—7660 ft.

The Canadair CL-44 is also available as a passenger or as a convertible passenger/cargo aircraft.

CANADAIR
LIMITED, MONTREAL
the Canadian Subsidiary of
GENERAL DYNAMICS CORPORATION

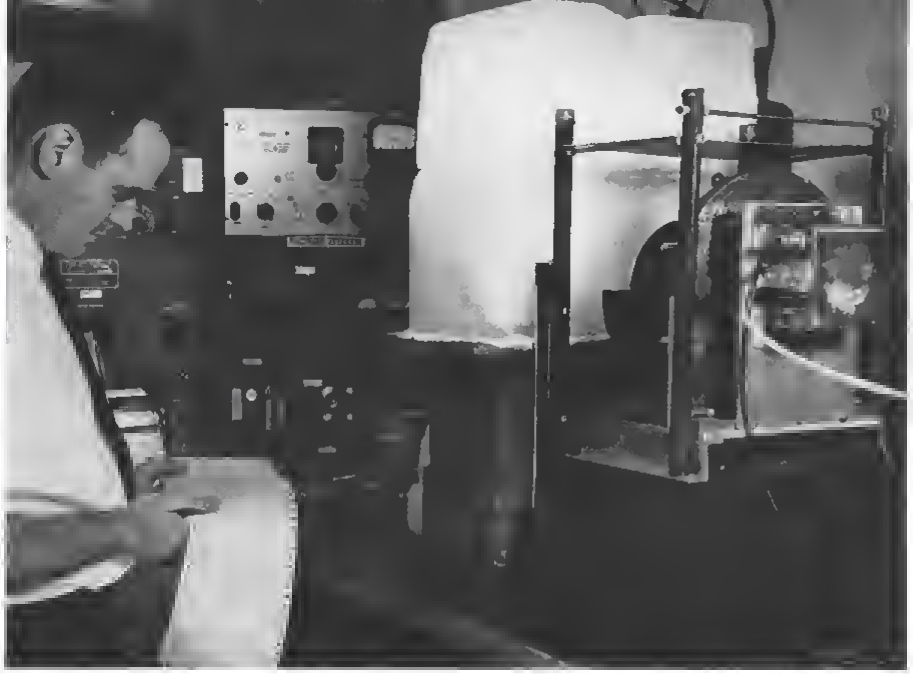
CA59-CL44-1 AL

Airline Traffic—August, 1959

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U S Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	705,201	567,135	76 3	1,766,920	969,475	8,976,381	66,115,853	63 4
Braniff	173,244	78,014	56 8	315,931	192,907	678,134	5,672,771	47 7
Capital	337,514	137,269	58 6	455,135	309,919	418,359	14,330,325	51 5
Continental	113,247	60,087	62 3	129,722	91,955	228,696	6,110,398	56 8
Delta	255,491	129 461	57 1	386,557	335,252	1.302 122	14,455 206	52 1
Eastern	732,845	402 406	52 92	990,841	596,616	1,460,046	41,734 968	43 20
National	138,682	83 987	55 2	230,663	71,670	511 887	8,903 309	45 5
Northeast	130 396	48 089	55 0	87,576	45,089	109,577	4,847 601	44 3
Northwest	171 338	139,263	63 3	512,385	250 761	1,343,211	15,462 697	54 2
Trans World	484 711	484,052	78 4	1 325,614	817 516	2,432,768	58 951 902	66 7
United	672 512	481 420	74 1	2,390 568	1,203 004	6,240 144	56,625 116	64 7
Western	147,744	96,926	66 3	277,404	101 906	280 367	9,932,108	55 8
INTERNATIONAL								
American	11 959	11,759	72 3	9 689	953	190,658	1,415 120	72 1
Braniff	4,996	9,378	61 6	12,869		99,124	1 126 155	54 5
Caribbean-Atlantic	32,397	2,259	70 0	1,620		4,856	245,491	72 8
Delta	5,046	6,407	58 2	6 517		26,022	745,983	50 0
Eastern	45,182	65,209	66 67	76,039		141,063	6,921,177	62 30
Mackey	12,722	2,539	58 4		84	4,443	276,169	57 6
National	8,057	5,345	56 3	11,490	7,695	36 828	622,374	50 3
Northwest	21,608	41,654	64 8	1,114,186	24,698	1 037,496	6,344,746	67 1
Pan American								
Alaska	7,261	7,348	73 2	32,330		187,276	1,014,255	70 1
Atlantic	137,347	191,337	76 5	1,220,673		2,778,152	23,925 126	65 2
Latin American	138 057	160,420	78 8	396,185		4,606,021	19,997 235	72 2
Pacific	35 427	136,636	86 9	1,281,746		2,178,276	17,562 530	79 3
Panagra	11,404	17 648	66 1	67,750		473 885	2,435 253	64 6
Resort	58	241	27 2			1,758 985	1,788 393	77 6
Trans Caribbean	10,392	16,438	86 5			327 902	1,657 708	80 6
Trans World	42,388	134,989	73 0	825,423		1,987,765	16,653 011	69 9
United	15,814	39,291	98 0	155 494		100,551	4 275,284	85 9
Western	5,430	8,443	73 6	13,598		13 039	911,242	73 4
LOCAL SERVICE								
Allegheny	58,920	10 580	58 7	10,982	23,616	34,723	1 079 606	48 7
Bonanza	20,128	4,977	44 2	5,861	2,192	10,371	493 187	42 6
Central	14,954	2,972	38 8	6,491	4,263	11,206	306,644	35 1
Frontier	33,373	8,588	40 3	23,482	11,117	75,545	937 323	44 6
Lake Central	20,084	3,169	38 9	4,126	21,645		326 062	42 6
Mohawk	46,798	9,321	54 1	9,373	17,072	17,991	933 633	54 2
North Central	90 628	16,556	47 78	34,157	53,195	32,618	1,727 811	48 45
Ozark	49 529	8,561	43 3	13 869	30,633	36,303	899,003	46 2
Pacific	46,620	10,252	60 7	16,849	6,018	10,904	1,011,256	59 6
Piedmont	45,605	9,811	47 2	17,406	15,895	19 668	994 052	48 2
Southern	16 948	3,069	38 6	6 651	8 681	13 878	323 545	39 4
Trans-Texas	26 801	6,451	39 4	17,855	10,791	37,315	683 903	46 0
West Coast	34,472	7,559	46 83	8,618	4,575	16,142	751 259	47 99
HAWAIIAN								
Aloha	41,436	5,996	71 1	2,627		5,774	496,037	67 2
Hawaiian	58,669	10,745	66 0	2 732		148 328	1 051,443	64 2
CARGO LINES								
AAXICO*								
Aerovias Sud Americana						509,716	509,716	86 7
Flying Tiger	3 048	13,317	98 9	31,097	61,135	9,965,239	11,409,160	85 1
Riddle								
Domestic				4,901	29,764	1,128,930	1,163,595	70 7
Overseas				1,366		428,904	430 270	68 1
Seaboard & Western	181	737		371,361		2,066,409	2,516 561	56 9
Slick	3,731	23 842	98 26			4,129,667	6,513,926	99 11
HELICOPTER LINES								
Chicago Helicopter	21,435	391	57 3	1,233			38 464	47 4
Los Angeles Airways	5,663	194 5	62 9	4 375	2,354		25 283	70 4
New York Airways	14,897	290	57 3	1,418	1,077	608	30 752	55 7
ALASKA LINES								
Alaska Airlines	10,840	9 538	63 7	58,096	4 710	393,512	1 403 510	63 0
Alaska Coastal	8 577	662	60 6	3,624		6,051	96 962	63 5
Cordova	1 983	293	41 5	4,896		49,642	84,700	47 9
Ellis	7,576	486	63 4	1,978		4,049	55,173	71 9
Northern Consolidated	3,988	1,296	57 8	33,389		70,587	243,781	68 7
Pacific Northern	17,396	17,061	68 2	111 969	7,722	328,774	2,293 197	74 5
Reeve Aleutian	1,663	1,404	39 7	38,818		71,695	263,197	59 4
Wien Alaska	6 885	2 711	40 6	39,998		320,126	633,983	54 2

* Not available

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board



TESTING of infrared horizon sensors for use in space vehicles was accomplished in the rig above. Infrared-sensing unit is mounted on the plate at right in the photo. It is scanning the blocks of dry ice at center, with the horizon simulated by a black semicircular plate between the ice and the infrared-sensing unit.

Nose Cone Tests Pay Space Lab Bonus

By J. S. Butz, Jr.

Philadelphia—Development testing of equipment for space vehicles and for measuring physical phenomena in space has been an important bonus in the flight test program of the General Electric Mark 2 heat sink nose cone, the first Air Force IRBM and ICBM warhead to become operational.

A wide variety of control, navigation and power subsystems for space vehicles plus instrumentation for making basic scientific observations above the atmosphere has occupied the space normally reserved for a nuclear weapon during many of the developmental firings of the Air Force Thor and Atlas missiles.

This program to take maximum advantage of ballistic missile tests has been termed "piggy-back" by the Air Force. General Electric calls it the Space Lab concept. General Electric's Missile and Space Vehicle Department has developed 18 different internal configurations of the Mark 2 nose cone to carry this instrumentation and equipment in a program parallel to the primary task of designing tactical configurations for the ballistic missile reentry vehicle.

Primary purpose of all the Air Force IRBM and ICBM tests thus far has been to test and perfect a weapon system, but the adoption of the piggy back principle also has enabled these firings to contribute materially to the rapid introduction of a new era in development testing. Test capabilities of this new era are vital in the development of reliable space vehicles, and they are now being planned in detail by the military services and the National Aeronautics and Space Administration.

Satellite test laboratories for space vehicle equipment and systems will be the main addition to existing development testing techniques. These satellite laboratories will stay aloft for months and will automatically cycle the equipment under test through many simulated space missions. While elaborate ground installations are now being built to simulate much of the space environment, there is no way of completely duplicating space conditions on earth.

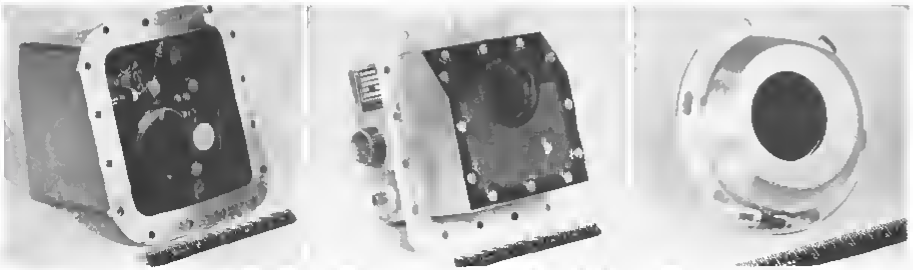
Ground laboratories will allow close observation of test work and greatly facilitate the initial development of space systems, but the satellite laboratories will do the final proof testing in the true environment over time periods relative to useful space flight durations. Satellite laboratories would be recoverable and allow first hand examination of any equipment that malfunctions. This feature also provides conclusive proof that any system which operated properly according to the telemetry data was entrench undamaged after its trip through space.

NASA has indicated by congressional testimony that manned satellite laboratories will be necessary in the future as propulsion capacity increases.

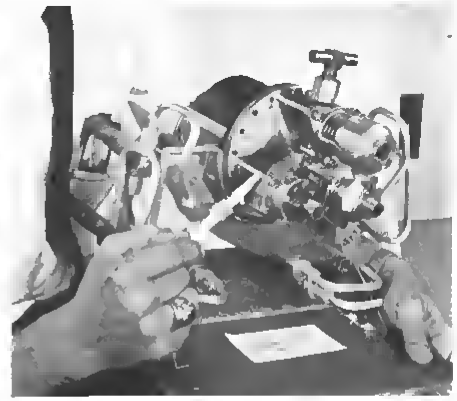
First of the unmanned satellite laboratories has already been fired in the Discoverer Program managed by the Advanced Research Projects Agency. The recoverable portion of this vehicle, known as the Satellite Aeromedical Recovery Vehicle (SARV), was also designed by the Missile and Space Vehicle Department.

SARV has a life support system which can keep small biological specimens alive for 54 hr., and equipment for ejection from orbit, thrust vectoring and recovery. Design of the life support system allows 12 hr. for the pre-launch phase, 27 hr. in orbit, 10 hr. for recovery operations and 5 hr. for return to base.

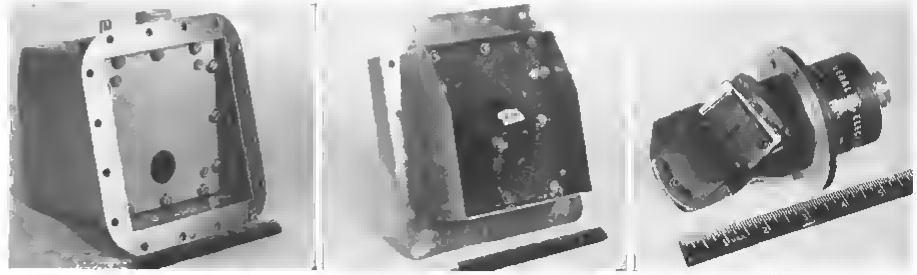
In six firings during the Discoverer



DEVELOPMENT of the suntracker units which provide a reference for space vehicle navigation and attitude control systems is shown from left to right. First units weighed more than six pounds. The present model on the right weighs less than one pound and is accurate to about 0.2 deg.



SPIN ROCKETS used to turn satellites rapidly about one axis so they will be stabilized during re-entry into the atmosphere are at left. The small unit produced 15 lb. sec. of impulse while the larger one is rated at 48 lb./sec. Each has a one-second burning time. Both units have end burning grains. Small thrust forces from six separate nozzles that are needed for fine attitude control of a satellite in orbit can be provided by the small solid propellant gas generator at right. The end burning grain has a usable impulse of 250 lb./sec. and a burning time of 10 sec. Thrust can be provided in small bursts over a long period, however, since the generator is controlled by on-off solenoid valves.



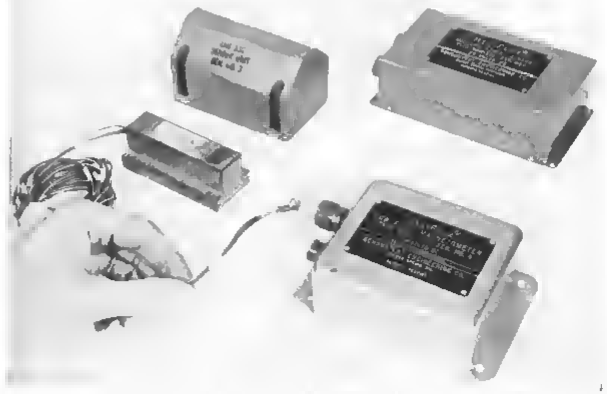
LATEST infrared horizon sensor which has flown in Space Lab experiments is shown in center. It weighs 10 lb. and includes a small computer which converts sensor readings into the signals needed to actuate an attitude control system. Newest sensor-computer unit is at right. It weighs about 2 lb. and takes about 25% of the volume required by the center unit. First GE infrared sensor unit is at left.

VACUUM BEARINGS for use in space have been designed by General Electric and used in equipment such as this rotating anode tube. Bearing utilizes a silver plate for lubrication and is capable of operating at 3,300 rpm. for 2,000 hr. at temperatures as high as 650C and a vacuum pressure equal to that in space

program, five attempts have been made to bring part of a satellite back from orbit.

Two of the Discoverer vehicles never achieved an orbit. Discoverer II, which was the first to orbit, was not a complete success because the re-entry vehicle was ejected prematurely and fell near Spitzbergen instead of in the Pacific as planned. This vehicle was spotted falling in its parachute, but without prepared recovery crews it was not retrieved. Subsequent re-entry vehicles from the Discoverer V and VI satellites were not recovered either.

These satellites were of considerable value, however. The satellite stabilization system functioned properly on all of the four flights where it had a chance to operate. Other test projects connected with the control of military satellites, listed as 'advanced engineer



MAGNETOMETERS may prove to be the basic sensing units for future missile and space guidance systems. Three units in background measured general strength of magnetic fields in space around earth during nose cone development flights from Cape Canaveral. Unit in foreground was later used to control warhead by sensing these fields

Space Lab Log

A summary of special tests conducted with Mark 2 and RVX series of re-entry vehicles on a non-interference basis from Cape Canaveral by General Electric's Missile and Space Vehicle Department for USAF organizations under the sponsorship of the Air Force's Ballistic Missile Division.*

Experiment No.	Purpose of Equipment
1E1	Evaluation of IR sensors and open-loop attitude measurements with free gyros.
1E2	Magnetometer and sun tracker, open-loop attitude measurements with free gyros.
1E6	Two-axis stabilized using IR sensors for pitch-yaw; data capsule with camera.
1E6A	Same as 1E6 plus solar cells.
1E7	Three axis stabilized with IR sensor and sun tracker, data capsule with camera.
1E7A	Same as 1E7.
1E7B	Same as 1E7, plus orbit circularization system test.
1E8	Same as 1E7 except using a magnetometer instead of a sun tracker.
1E8A	Same as 1E8.
J1	Emulsion packages.
J2	Three part program for low level, low frequency acoustic noise and vibration analysis.
J3	Micrometeorite grids.
J5	Measure of atmospheric density.
J6	Radiation sensor for re-entry shock measurements.
J7	Electric field measurements.
J8	Ion and electron-density probe.
J9	Calibrated aneroid micrometeorite detector.

* There were no failures due to installation or use of the GE-MSVD space lab equipment.

ing tests" by the Department of Defense, were also performed with success.

The expanding Air Force "piggyback" program which has been operational for almost a year has produced a large body of information and a number of important firsts in its space laboratory role. The weight of test equipment in these ballistic missile flights is well above that permitted on the most powerful sounding rockets. The testing times in space are also much longer during the flight of the re-entry vehicles for the weapons, with almost 25 min. available during an ICBM flight.

In this program, the GE Missile and Space Vehicle Department made the first infrared measurements of the interface between earth and space from very high altitudes in the fall of 1958, made the first successful magnetic flux